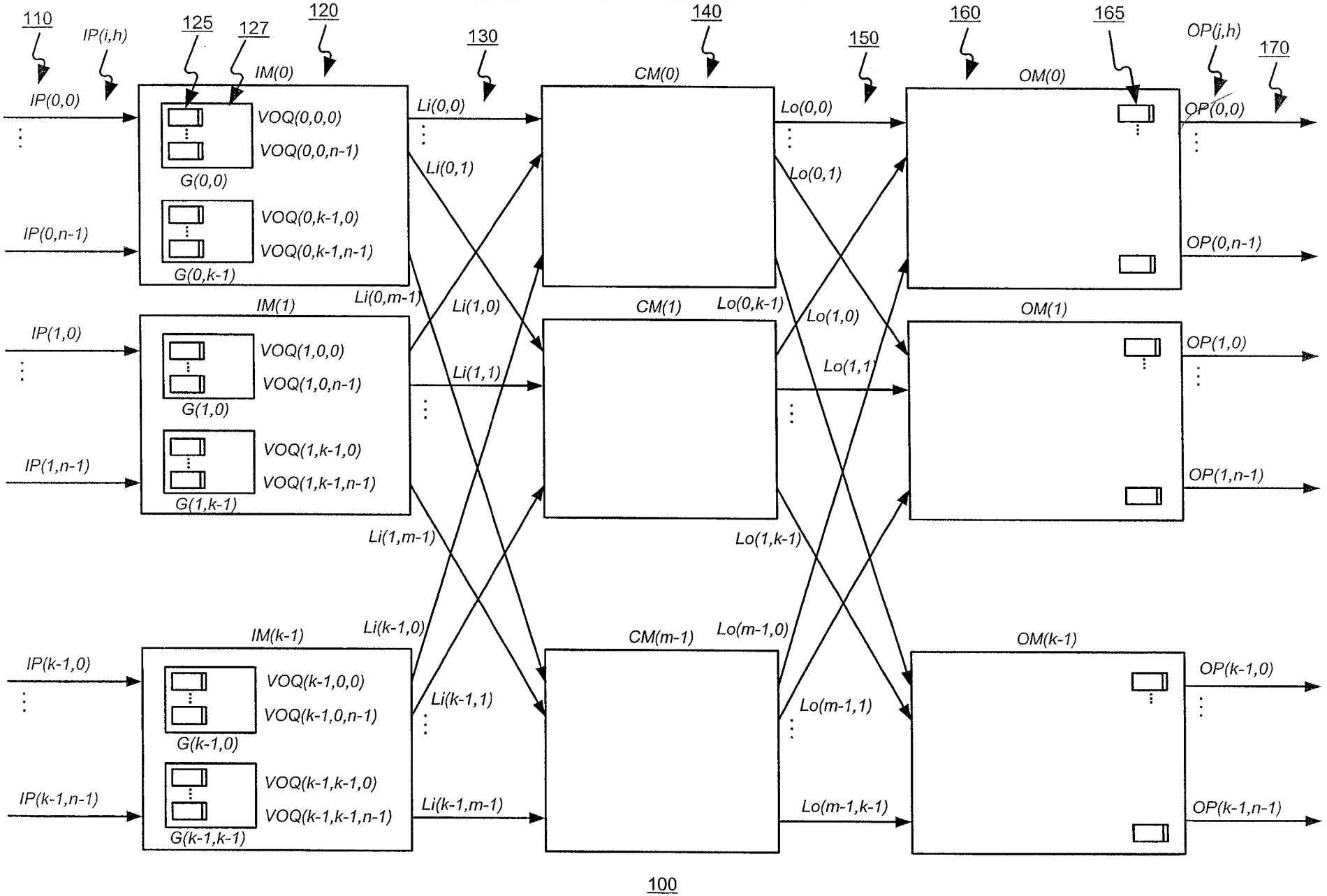

110
IP(i,h)
125
127
120
130
140
150
160
165
OP(j,h)
170
IP(0,0)
IM(0)
CM(0)
OM(0)
VOQ(0,0,0)
VOQ(0,0,n-1)
G(0,0)
Li(0,0)
Lo(0,0)
OP(0,0)
Li(0,1)
Lo(0,1)
IP(0,n-1)
VOQ(0,k-1,0)
VOQ(0,k-1,n-1)
G(0,k-1)
OP(0,n-1)
Li(0,m-1)
IM(1)
CM(1)
Lo(0,k-1)
OM(1)
Li(1,0)
Lo(1,0)
IP(1,0)
VOQ(1,0,0)
VOQ(1,0,n-1)
G(1,0)
Li(1,1)
Lo(1,1)
OP(1,0)
IP(1,n-1)
VOQ(1,k-1,0)
VOQ(1,k-1,n-1)
G(1,k-1)
OP(1,n-1)
Li(1,m-1)
Lo(1,k-1)
Li(k-1,0)
IM(k-1)
CM(m-1)
Lo(m-1,0)
OM(k-1)
IP(k-1,0)
VOQ(k-1,0,0)
VOQ(k-1,0,n-1)
G(k-1,0)
Li(k-1,1)
Lo(m-1,1)
OP(k-1,0)
IP(k-1,n-1)
VOQ(k-1,k-1,0)
VOQ(k-1,k-1,n-1)
G(k-1,k-1)
Li(k-1,m-1)
Lo(m-1,k-1)
OP(k-1,n-1)
100

FIGURE 1

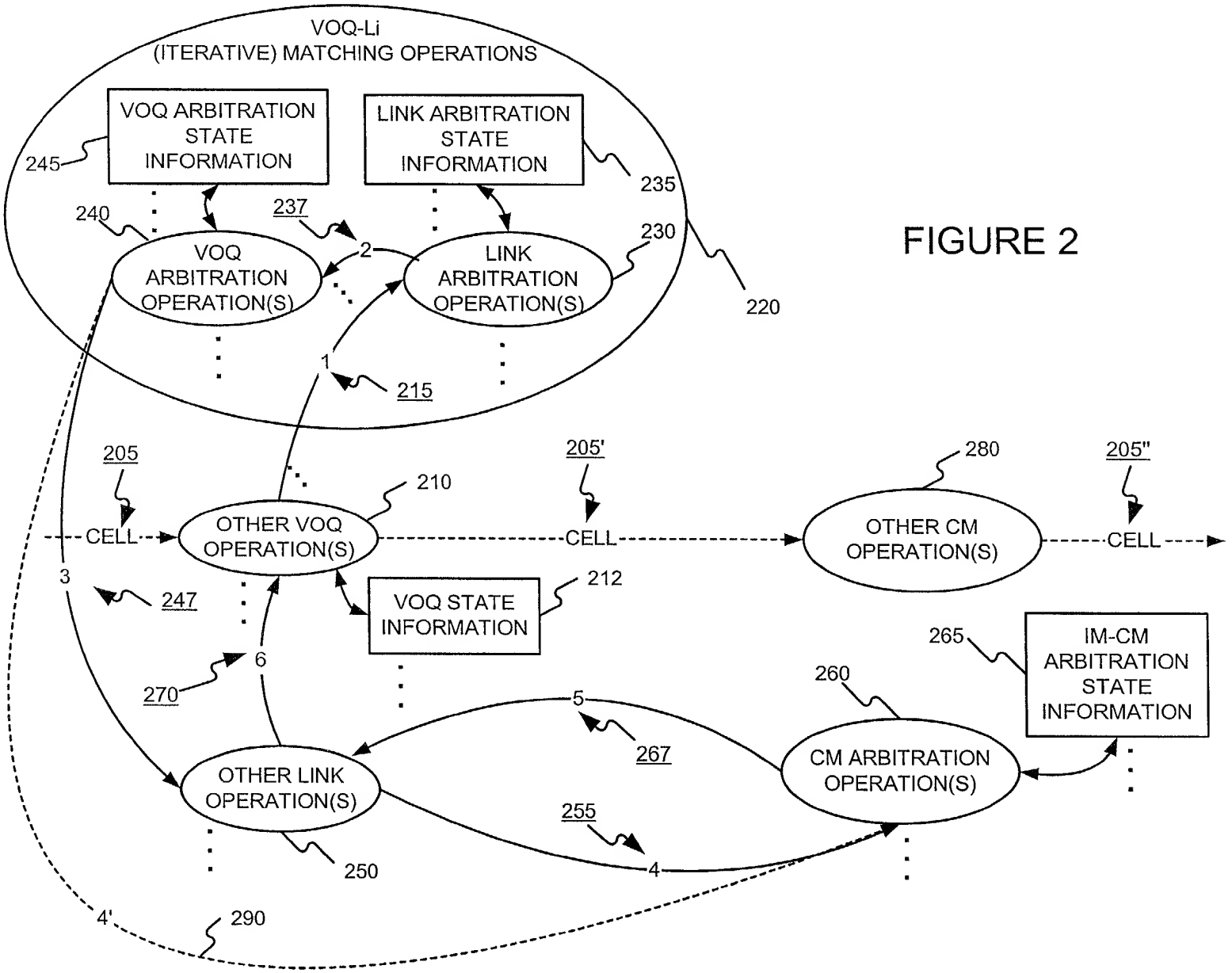

VOQ-Li
(ITERATIVE) MATCHING OPERATIONS
VOQ ARBITRATION STATE INFORMATION
LINK ARBITRATION STATE INFORMATION
245
235
240
237
230
VOQ ARBITRATION OPERATION(S)
LINK ARBITRATION OPERATION(S)
220
1
215
205
205'
280
205"
210
CELL
OTHER VOQ OPERATION(S)
CELL
OTHER CM OPERATION(S)
CELL
3
247
VOQ STATE INFORMATION
212
265
IM-CM ARBITRATION STATE INFORMATION
260
6
270
5
267
OTHER LINK OPERATION(S)
CM ARBITRATION OPERATION(S)
255
4
250
4'
290

FIGURE 2

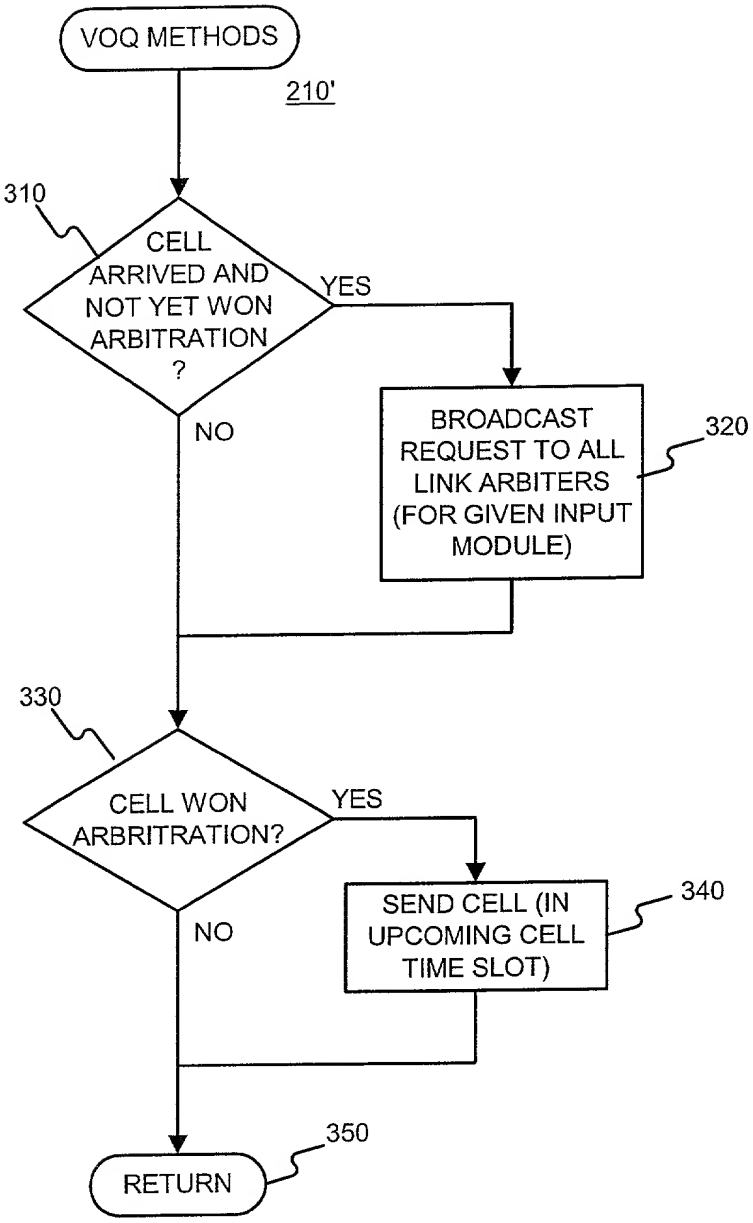

VOQ METHODS
210'
310
CELL ARRIVED AND NOT YET WON ARBITRATION ?
YES
NO
BROADCAST REQUEST TO ALL LINK ARBITERS (FOR GIVEN INPUT MODULE)
320
330
CELL WON ARBRITRATION?
YES
NO
SEND CELL (IN UPCOMING CELL TIME SLOT)
340
RETURN
350

FIGURE 3

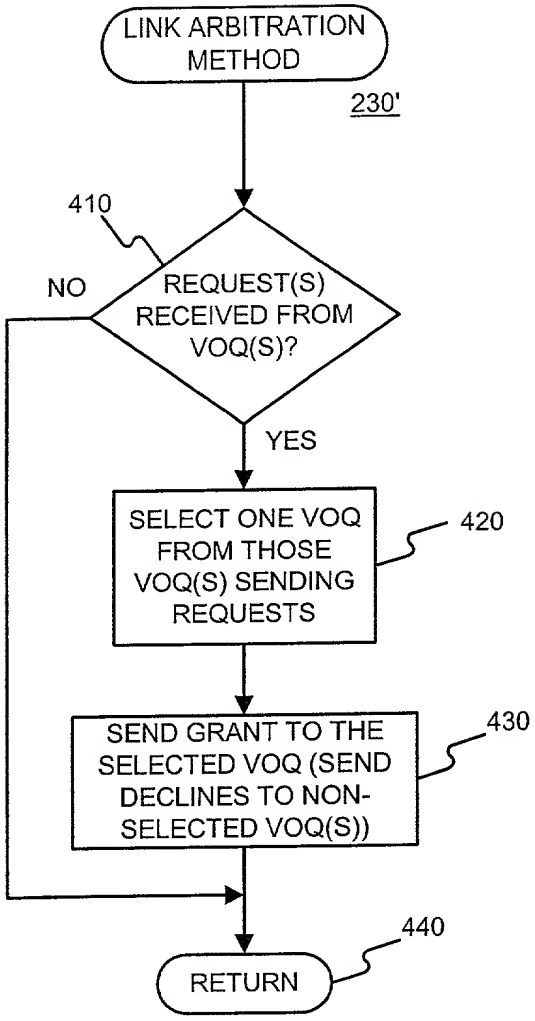

LINK ARBITRATION METHOD
230'
410
REQUEST(S) RECEIVED FROM VOQ(S)?
NO
YES
SELECT ONE VOQ FROM THOSE VOQ(S) SENDING REQUESTS
420
SEND GRANT TO THE SELECTED VOQ (SEND DECLINES TO NON-SELECTED VOQ(S))
430
440
RETURN

FIGURE 4

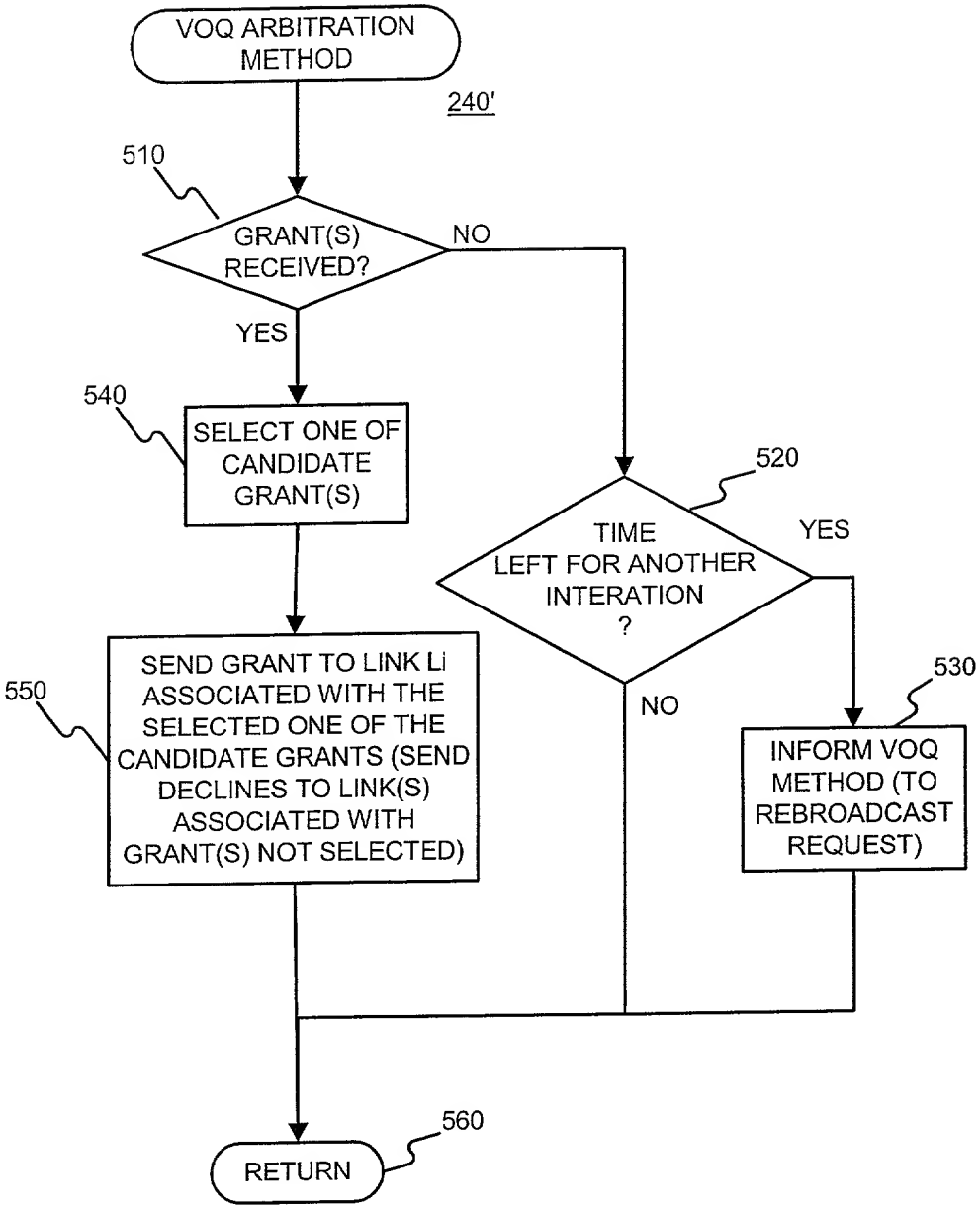

VOQ ARBITRATION METHOD
240'
510
GRANT(S) RECEIVED?
NO
YES
540
SELECT ONE OF CANDIDATE GRANT(S)
520
TIME LEFT FOR ANOTHER INTERATION ?
YES
NO
530
INFORM VOQ METHOD (TO REBROADCAST REQUEST)
550
SEND GRANT TO LINK Li ASSOCIATED WITH THE SELECTED ONE OF THE CANDIDATE GRANTS (SEND DECLINES TO LINK(S) ASSOCIATED WITH GRANT(S) NOT SELECTED)
560
RETURN

FIGURE 5

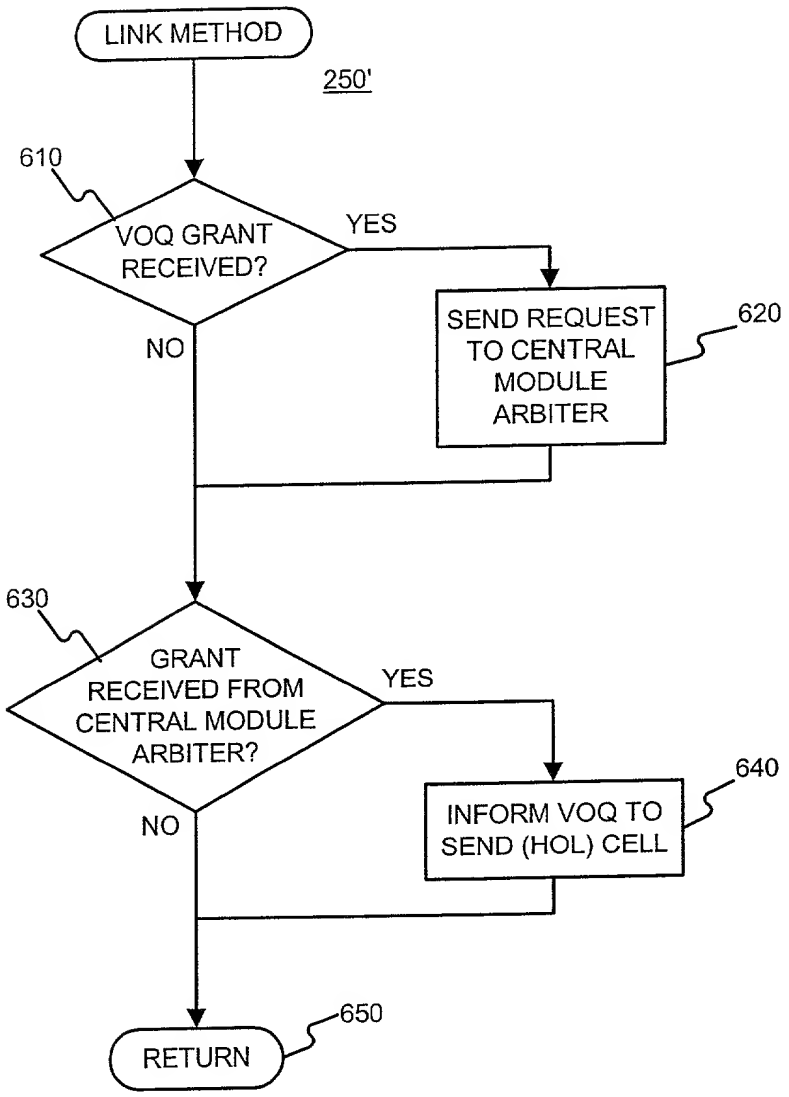

LINK METHOD
250'
610
VOQ GRANT RECEIVED?
YES
NO
SEND REQUEST TO CENTRAL MODULE ARBITER
620
630
GRANT RECEIVED FROM CENTRAL MODULE ARBITER?
YES
NO
INFORM VOQ TO SEND (HOL) CELL
640
RETURN
650

FIGURE 6

Docket No. 80278.0050

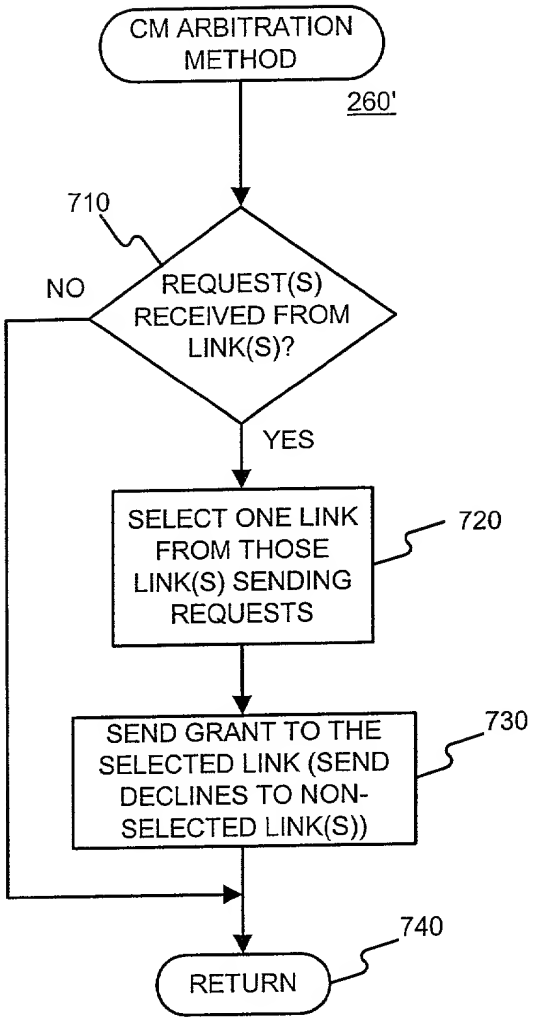


FIGURE 7

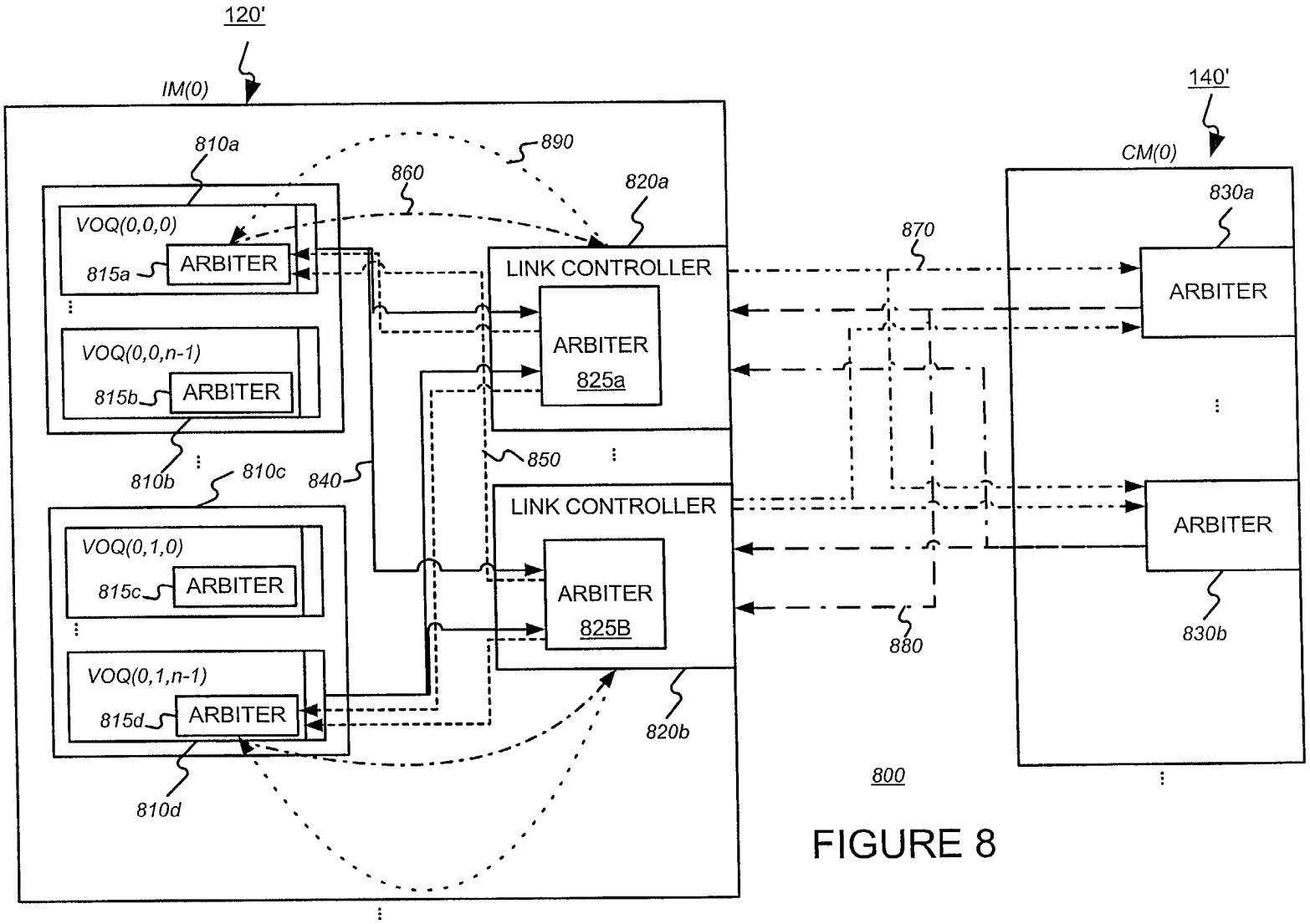
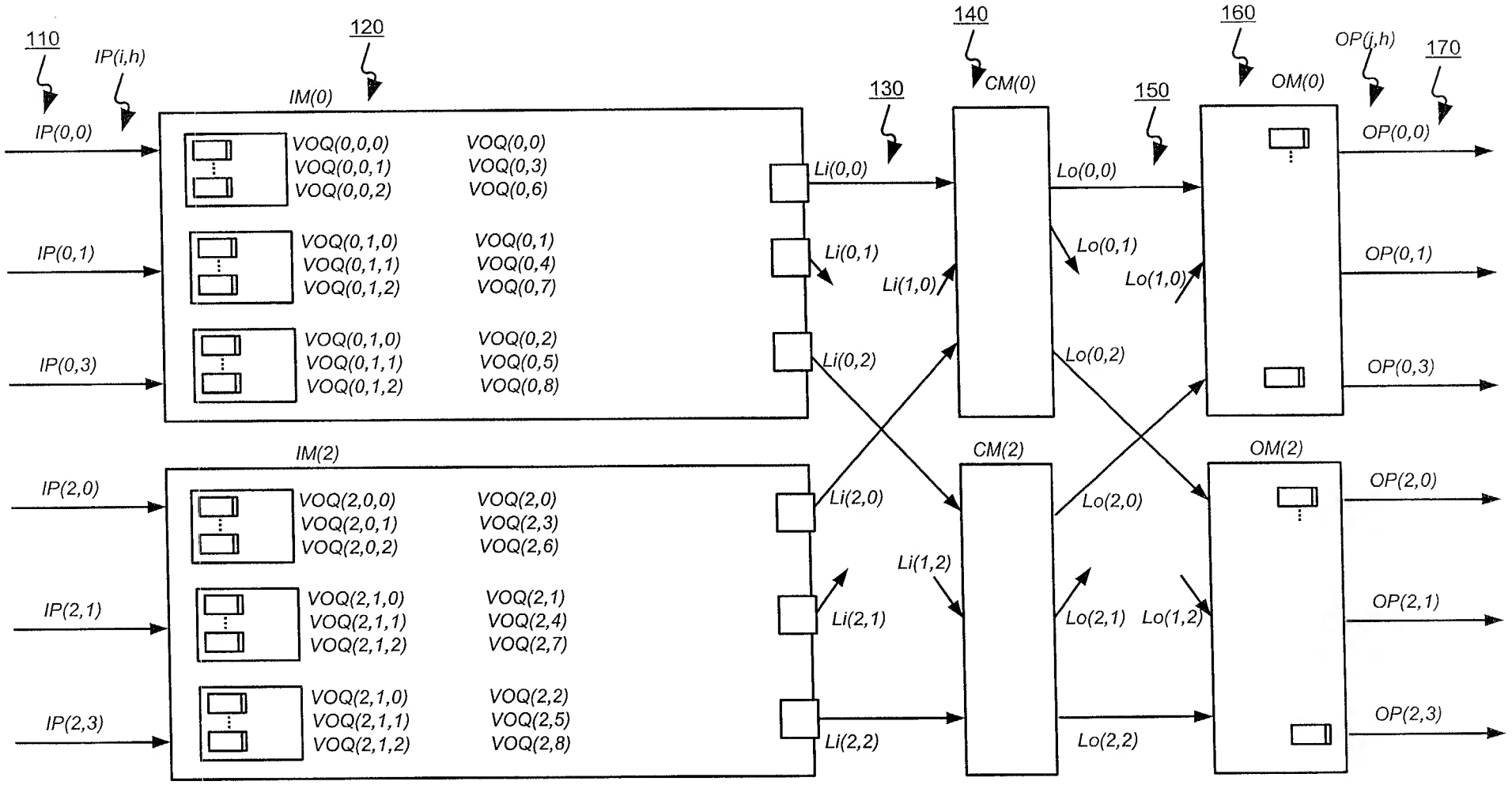

120'
IM(0)
140'
CM(0)
810a
890
860
820a
830a
870
VOQ(0,0,0)
815a
ARBITER
LINK CONTROLLER
ARBITER
825a
ARBITER
VOQ(0,0,n-1)
815b
ARBITER
810b
810c
840
850
LINK CONTROLLER
VOQ(0,1,0)
815c
ARBITER
ARBITER
825B
ARBITER
830b
880
VOQ(0,1,n-1)
815d
ARBITER
820b
810d
800

FIGURE 8

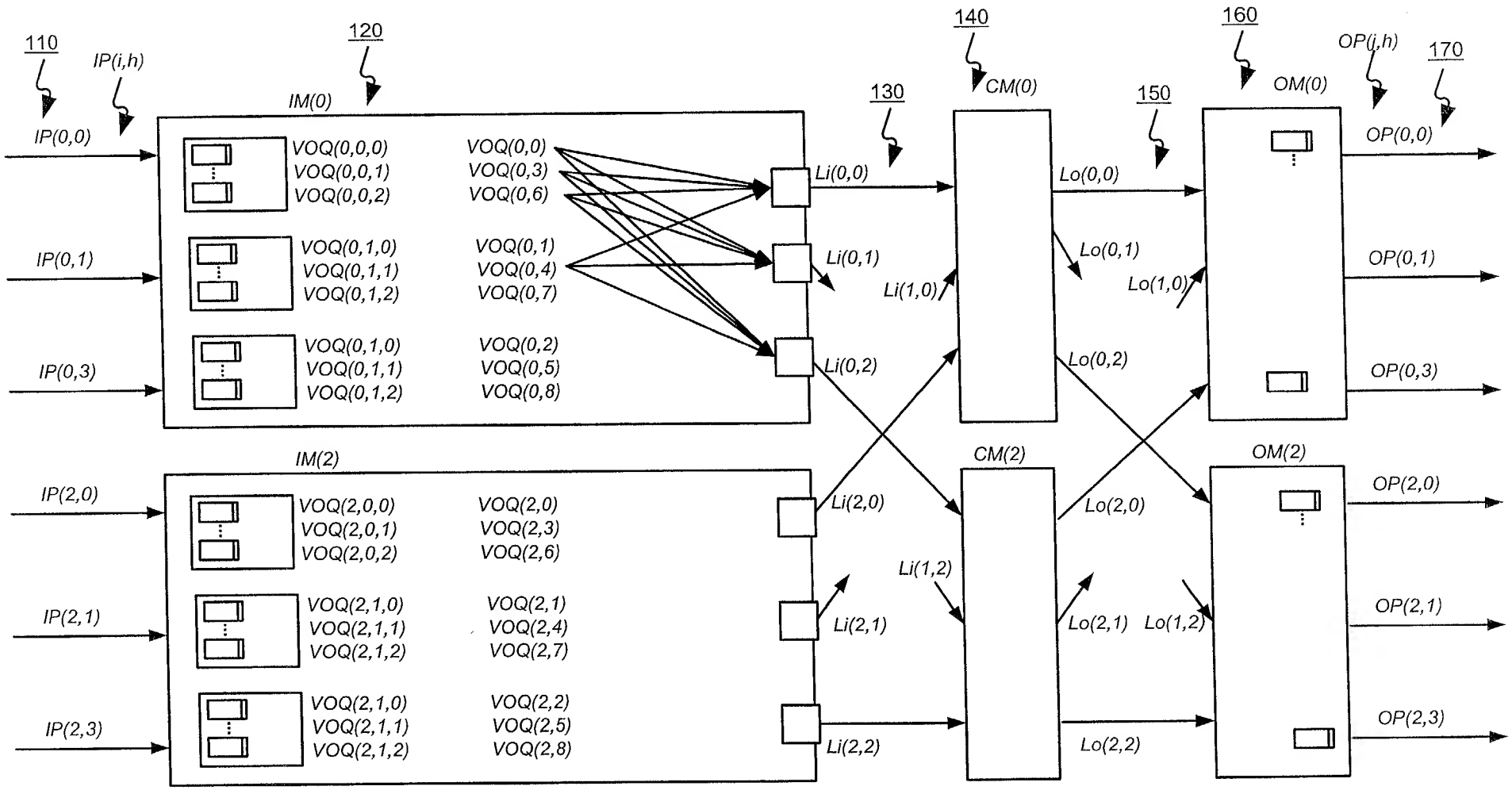
TOSZ0"9EOTT660



100'

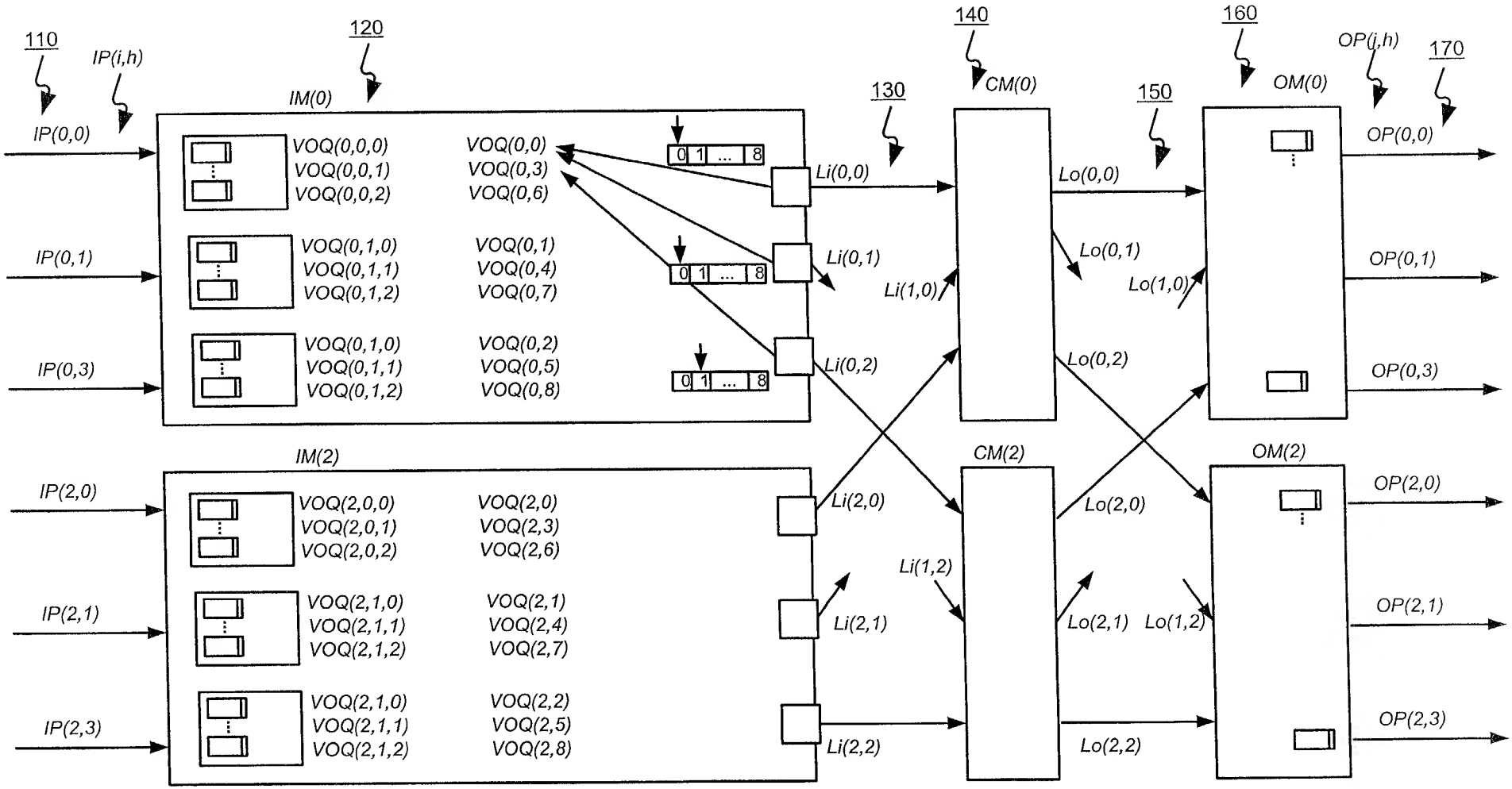
FIGURE 9a

TOE2C0"8E0T660



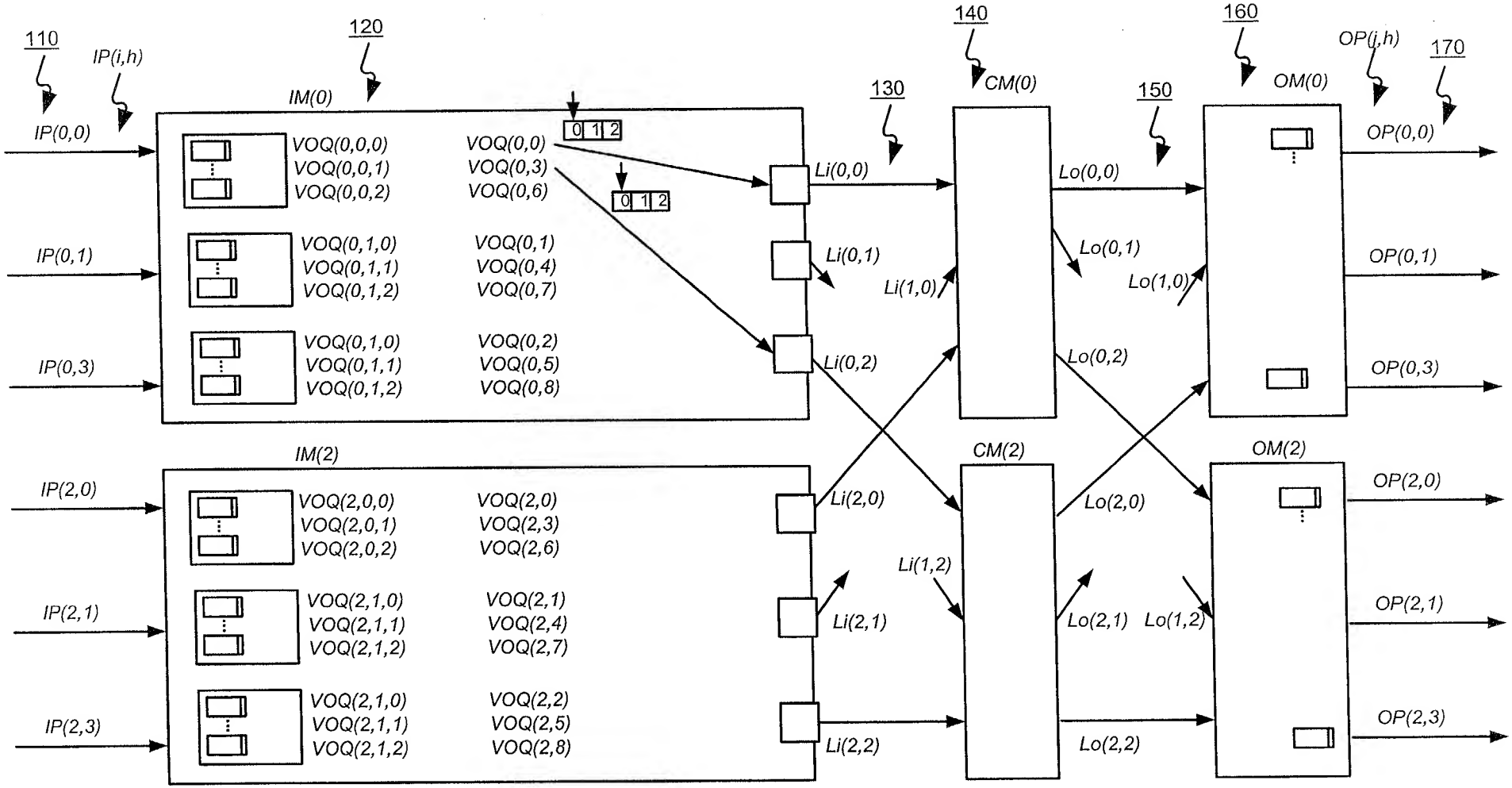
100'

FIGURE 9b



100'

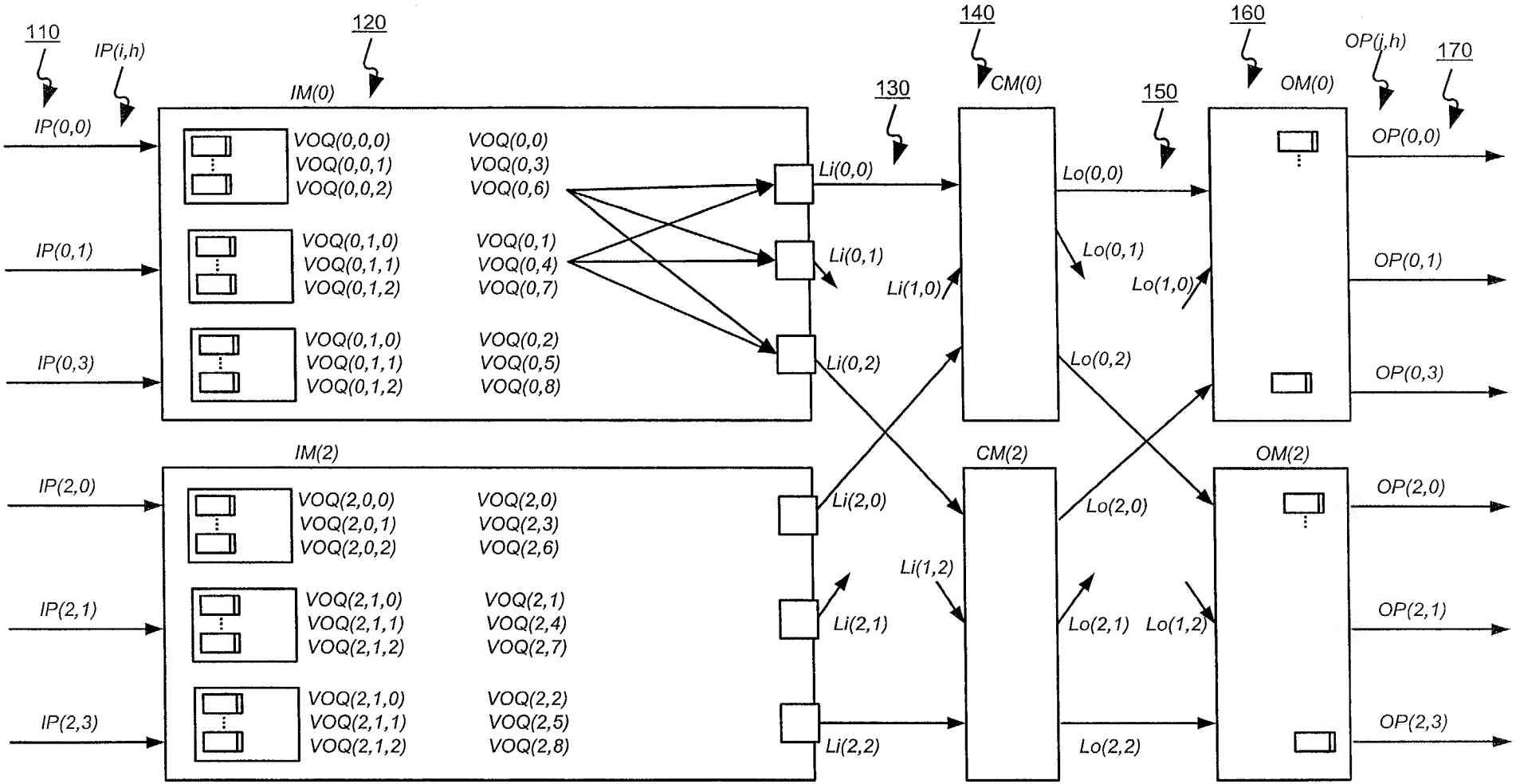
FIGURE 9c



100'

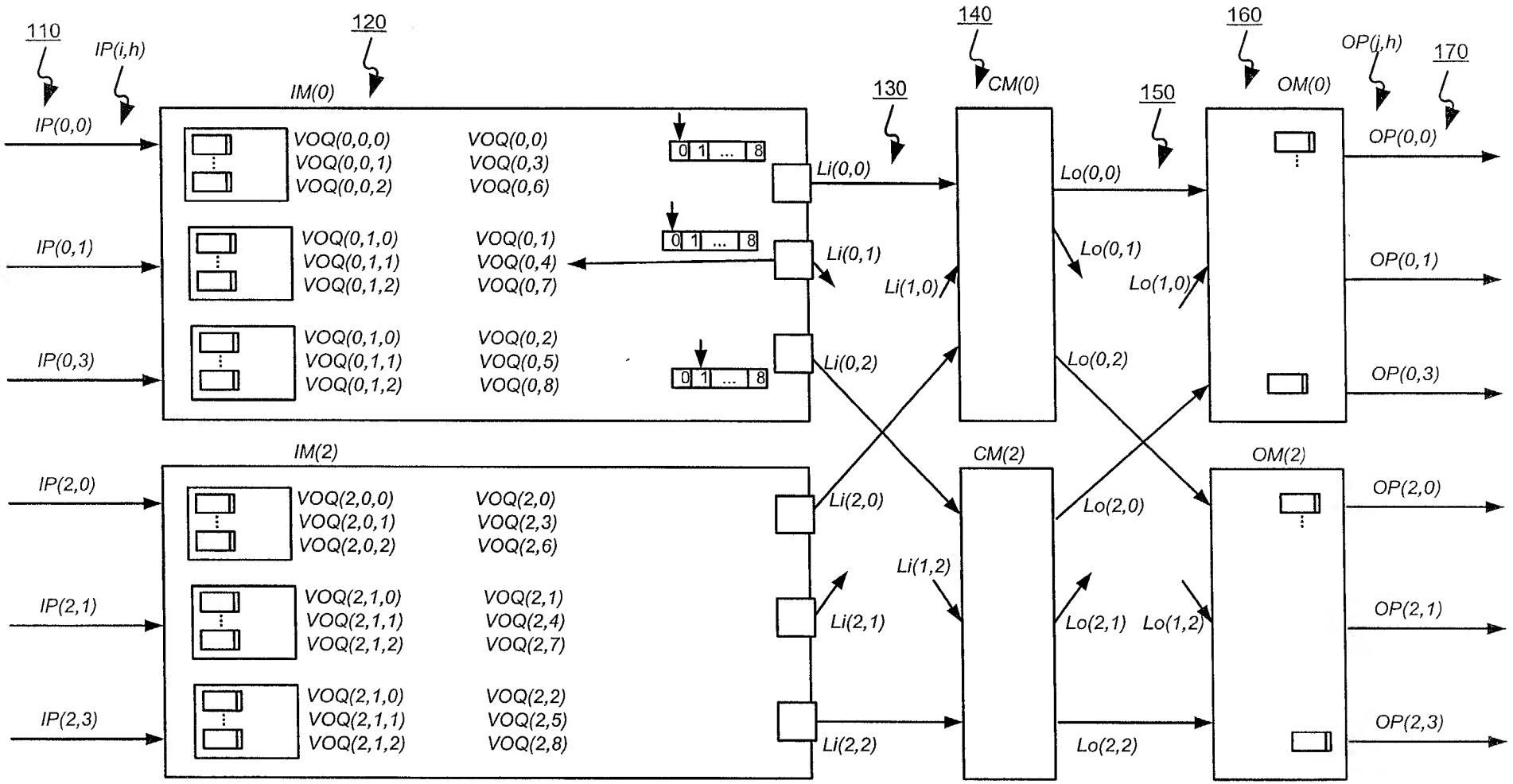
FIGURE 9d

TOE2C0 "BEOTT660



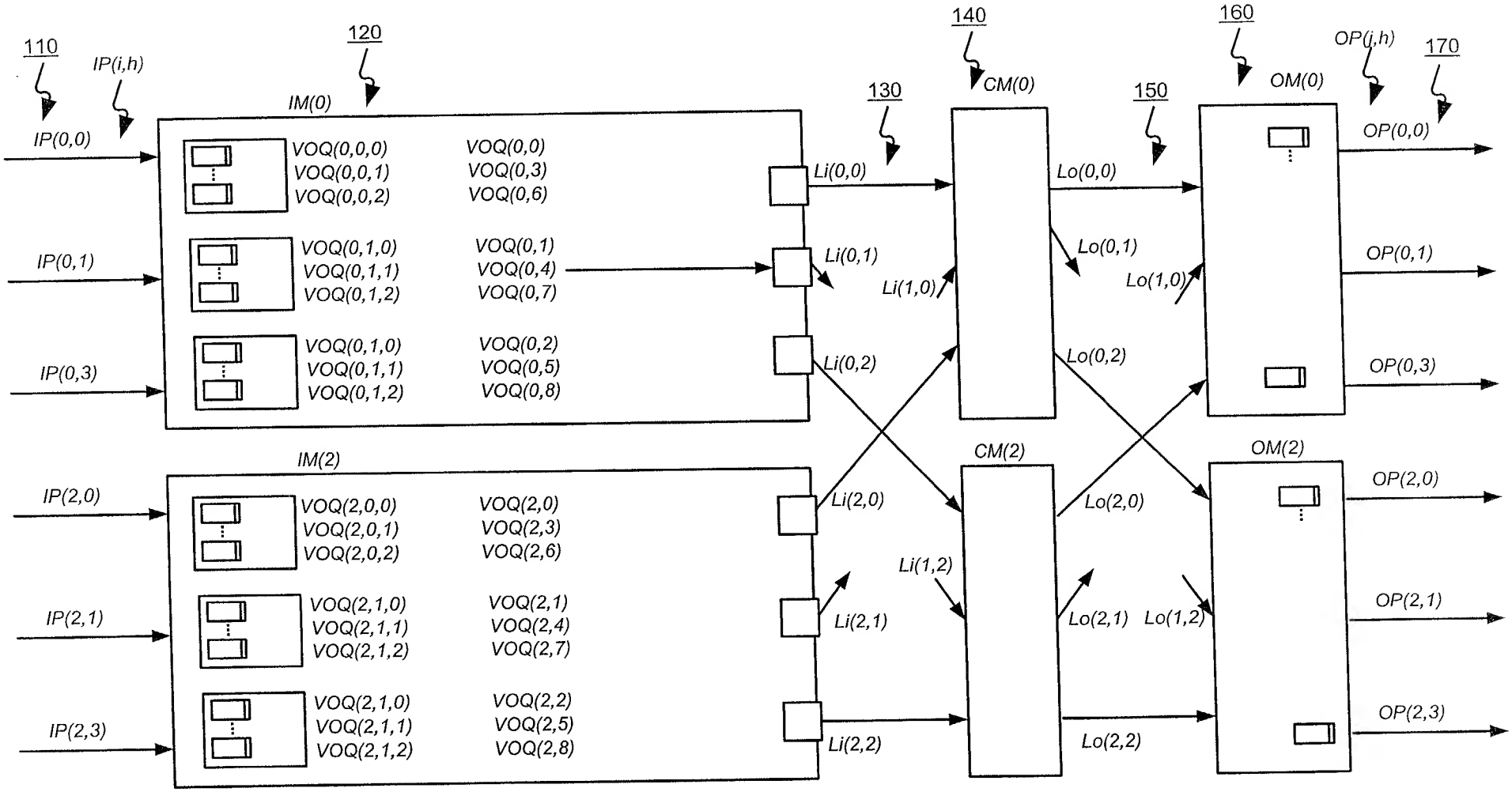
100'

FIGURE 9e



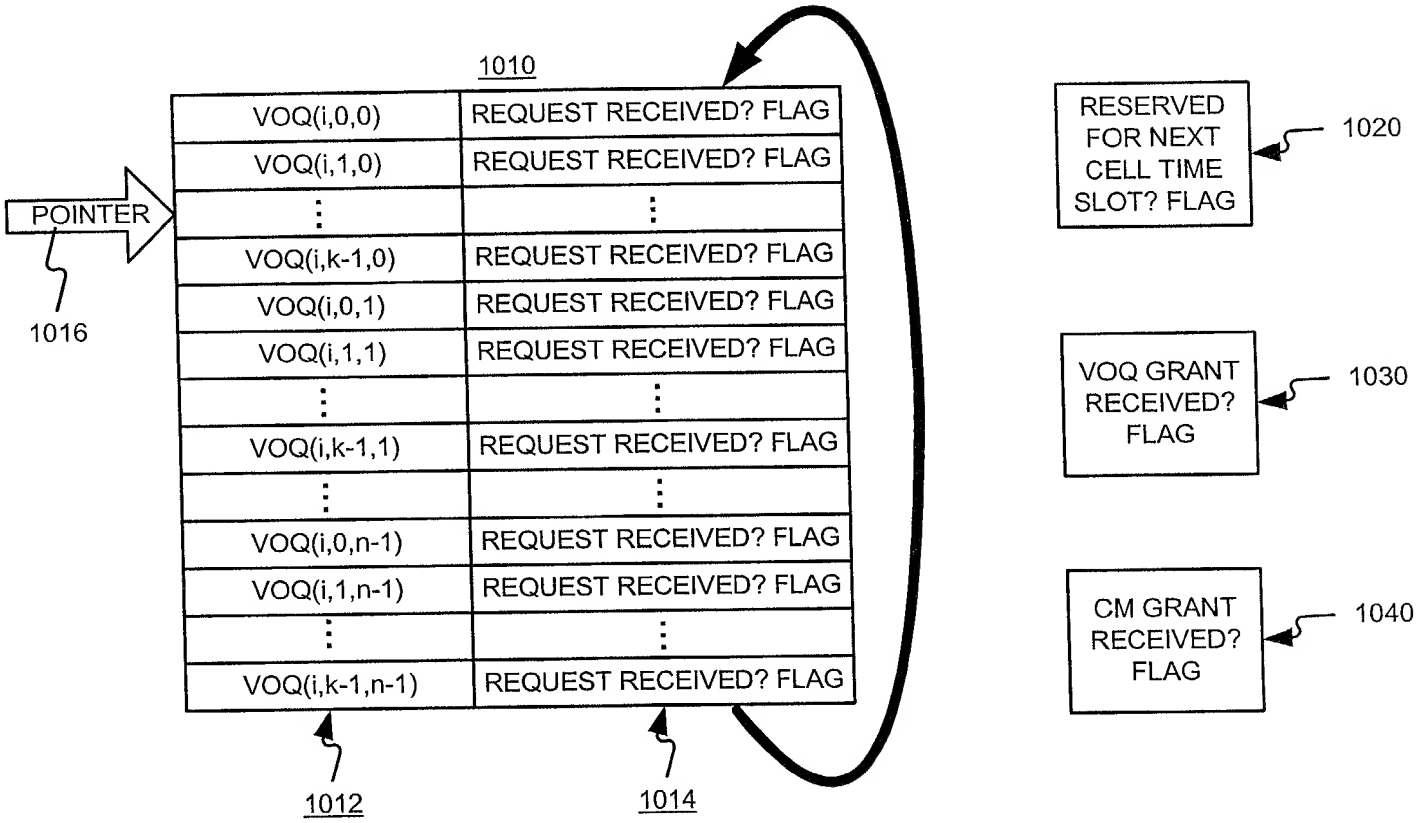
100'

FIGURE 9f



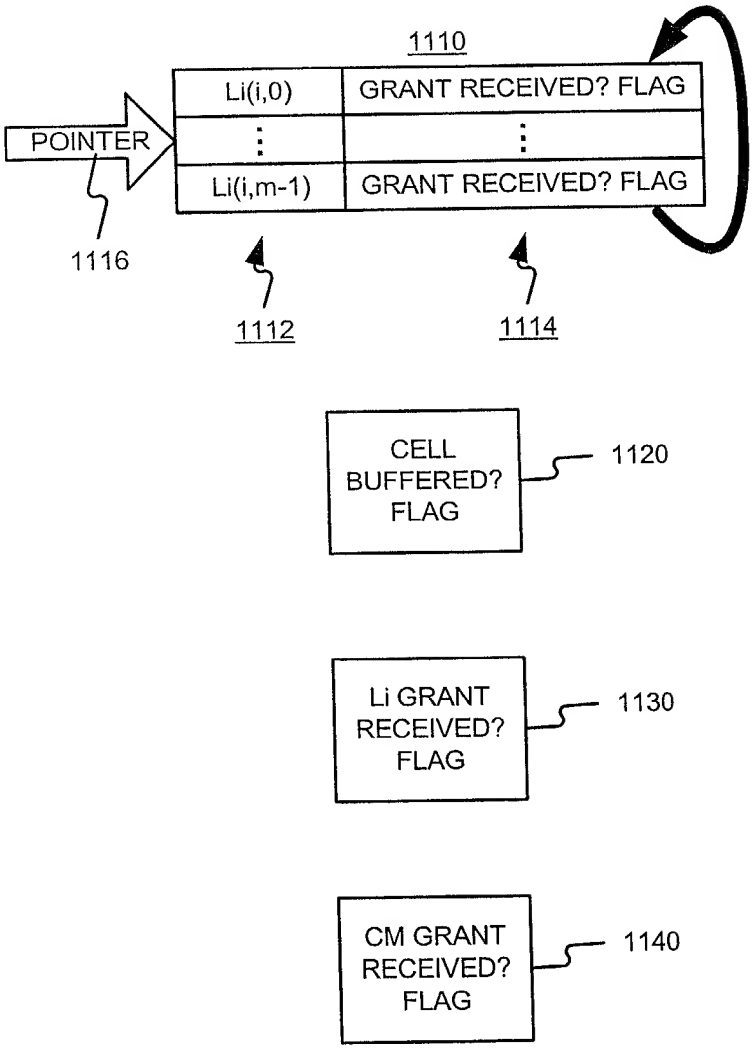
100'

FIGURE 9g



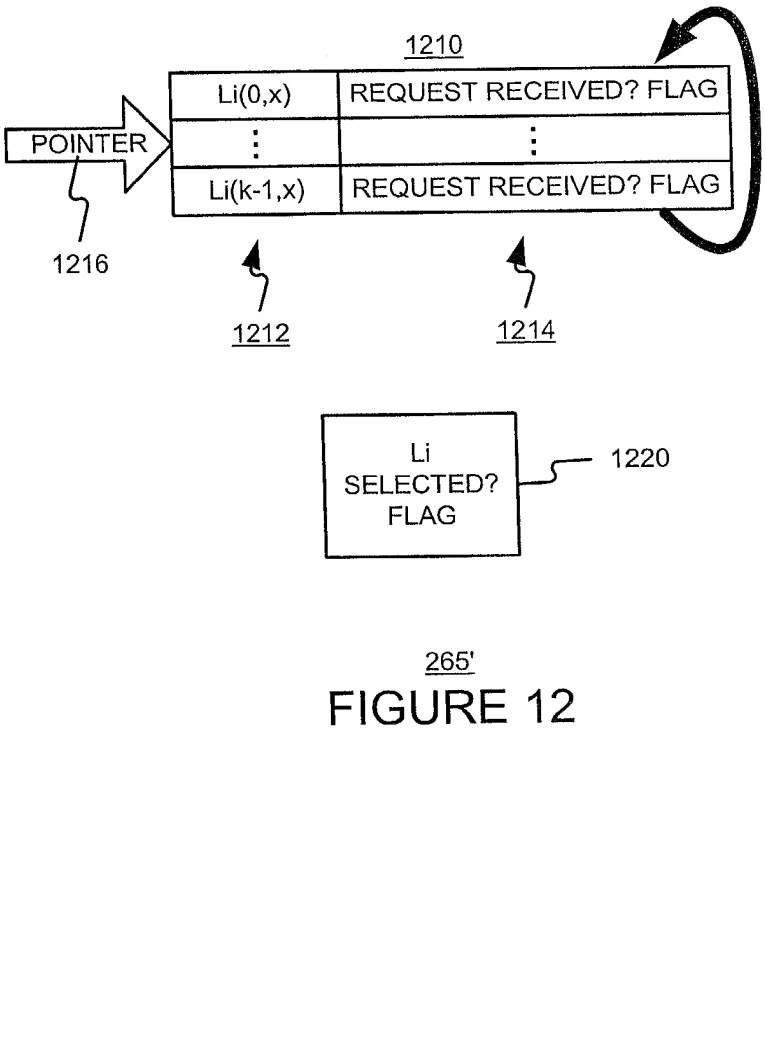
235'

FIGURE 10



245'

FIGURE 11



265'

FIGURE 12

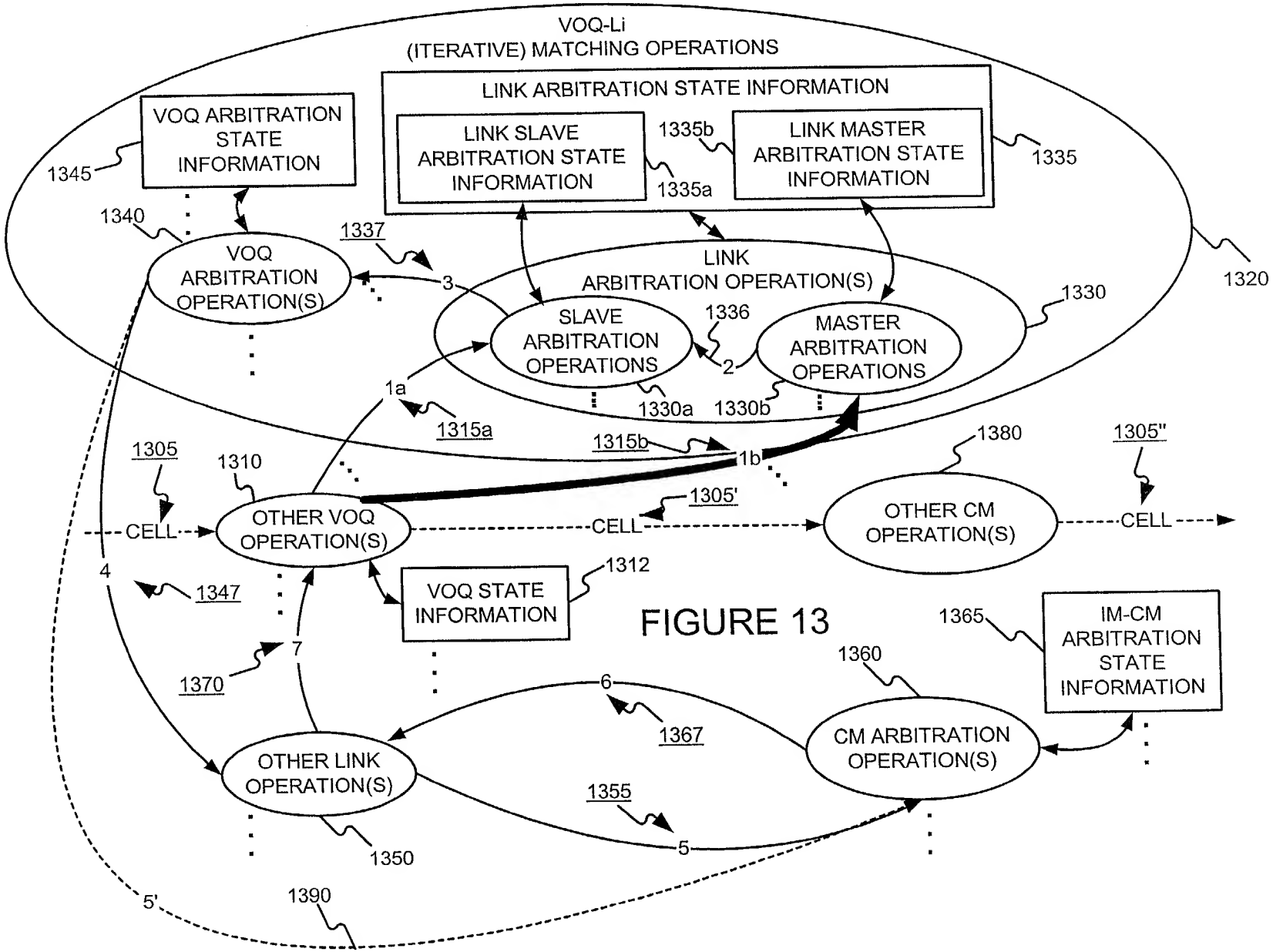

VOQ-Li
(ITERATIVE) MATCHING OPERATIONS
LINK ARBITRATION STATE INFORMATION
VOQ ARBITRATION STATE INFORMATION
LINK SLAVE ARBITRATION STATE INFORMATION
LINK MASTER ARBITRATION STATE INFORMATION
1345
1335b
1335a
1335
1340
1337
VOQ ARBITRATION OPERATION(S)
LINK ARBITRATION OPERATION(S)
1320
1330
SLAVE ARBITRATION OPERATIONS
MASTER ARBITRATION OPERATIONS
1336
1a
1315a
1330a
1330b
1315b
1b
1305
1310
1380
1305"
1305'
CELL
OTHER VOQ OPERATION(S)
OTHER CM OPERATION(S)
4
1347
VOQ STATE INFORMATION
1312
1365
IM-CM ARBITRATION STATE INFORMATION
1370
7
6
1360
1367
OTHER LINK OPERATION(S)
CM ARBITRATION OPERATION(S)
1355
5
1350
5'
1390

FIGURE 13

PD02N0-050402

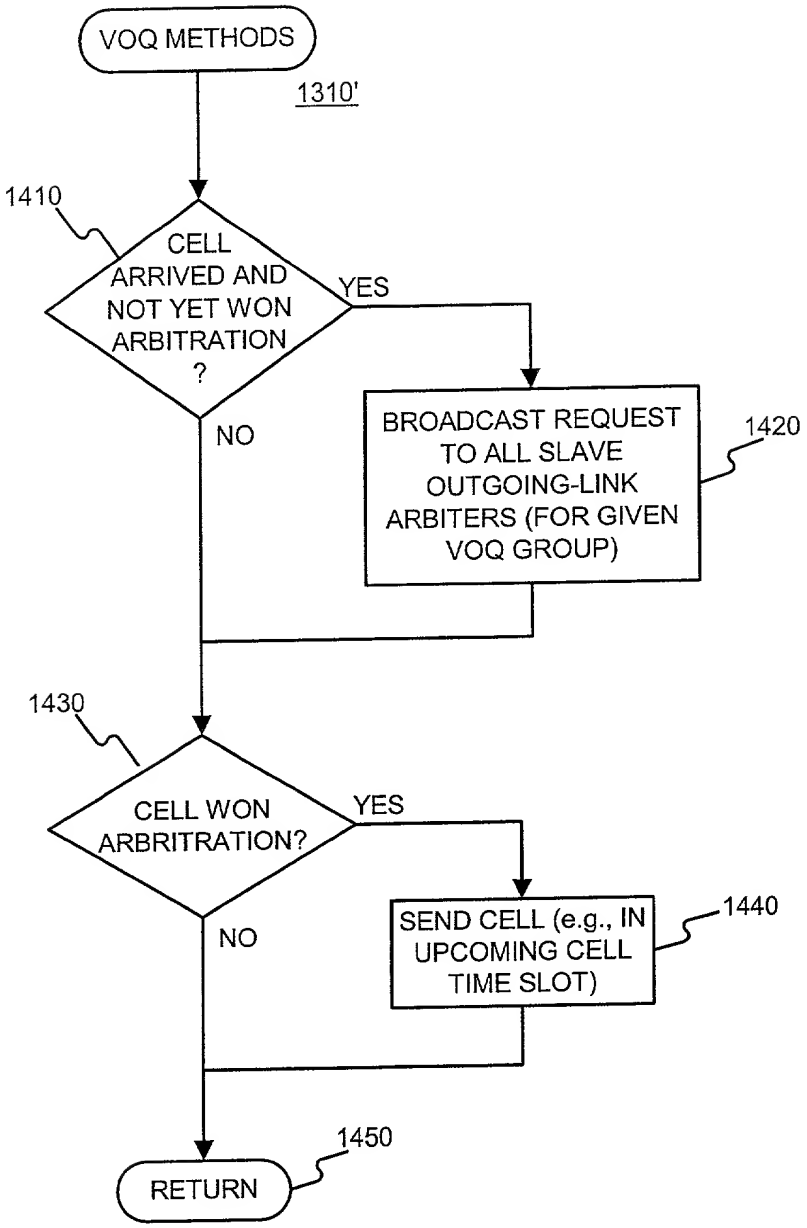


FIGURE 14

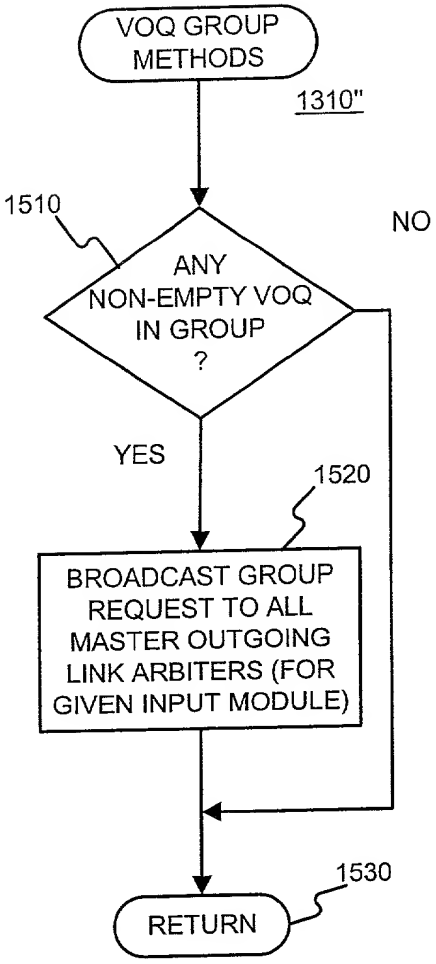

VOQ GROUP METHODS
1310"
1510
ANY NON-EMPTY VOQ IN GROUP ?
NO
YES
1520
BROADCAST GROUP REQUEST TO ALL MASTER OUTGOING LINK ARBITERS (FOR GIVEN INPUT MODULE)
1530
RETURN

FIGURE 15

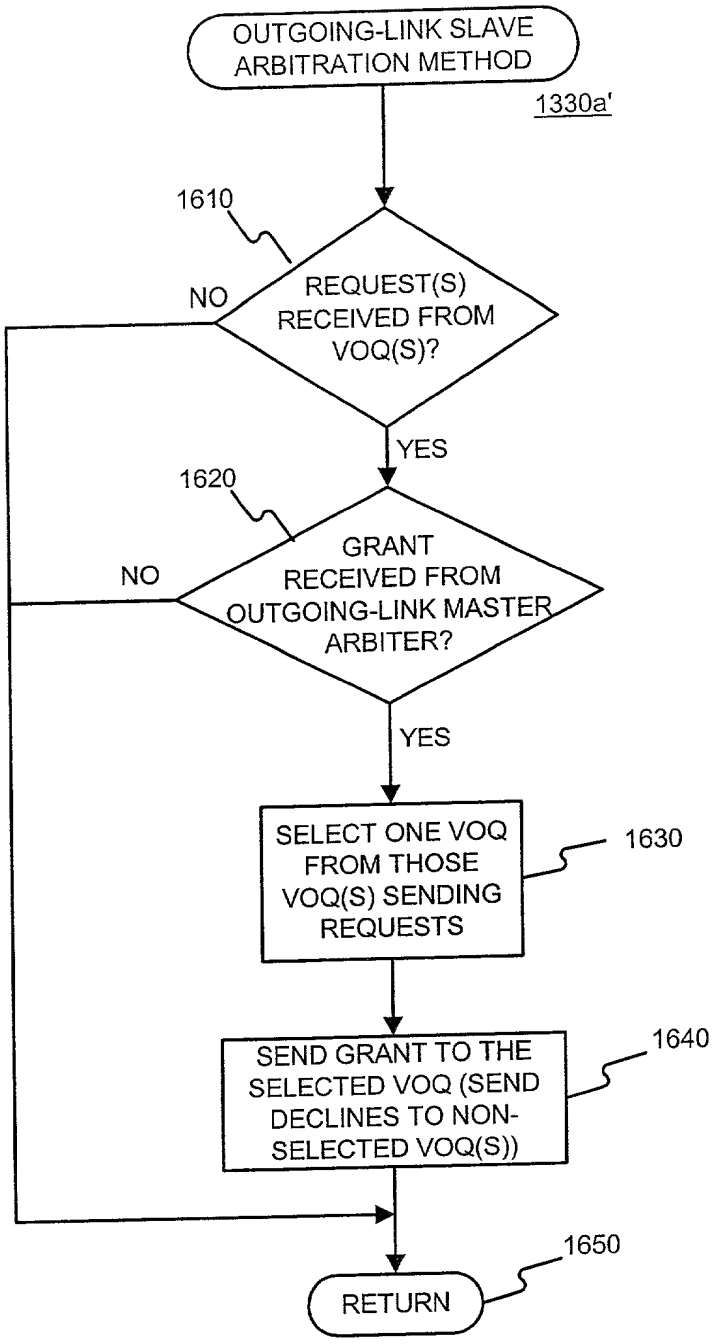

OUTGOING-LINK SLAVE ARBITRATION METHOD
1330a'
1610
REQUEST(S) RECEIVED FROM VOQ(S)?
NO
YES
1620
GRANT RECEIVED FROM OUTGOING-LINK MASTER ARBITER?
NO
YES
SELECT ONE VOQ FROM THOSE VOQ(S) SENDING REQUESTS
1630
SEND GRANT TO THE SELECTED VOQ (SEND DECLINES TO NON-SELECTED VOQ(S))
1640
1650
RETURN

FIGURE 16

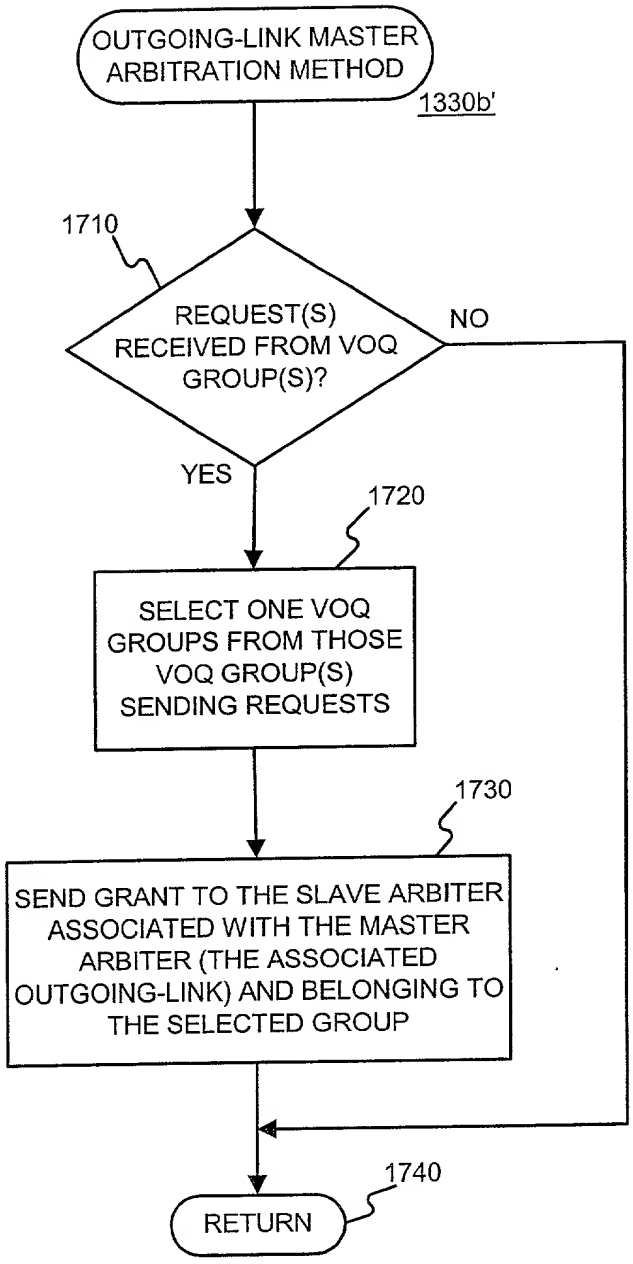

OUTGOING-LINK MASTER ARBITRATION METHOD
1330b'
1710
REQUEST(S) RECEIVED FROM VOQ GROUP(S)?
NO
YES
1720
SELECT ONE VOQ GROUPS FROM THOSE VOQ GROUP(S) SENDING REQUESTS
1730
SEND GRANT TO THE SLAVE ARBITER ASSOCIATED WITH THE MASTER ARBITER (THE ASSOCIATED OUTGOING-LINK) AND BELONGING TO THE SELECTED GROUP
1740
RETURN

FIGURE 17

Attorney Docket No. 95-1-0036.01

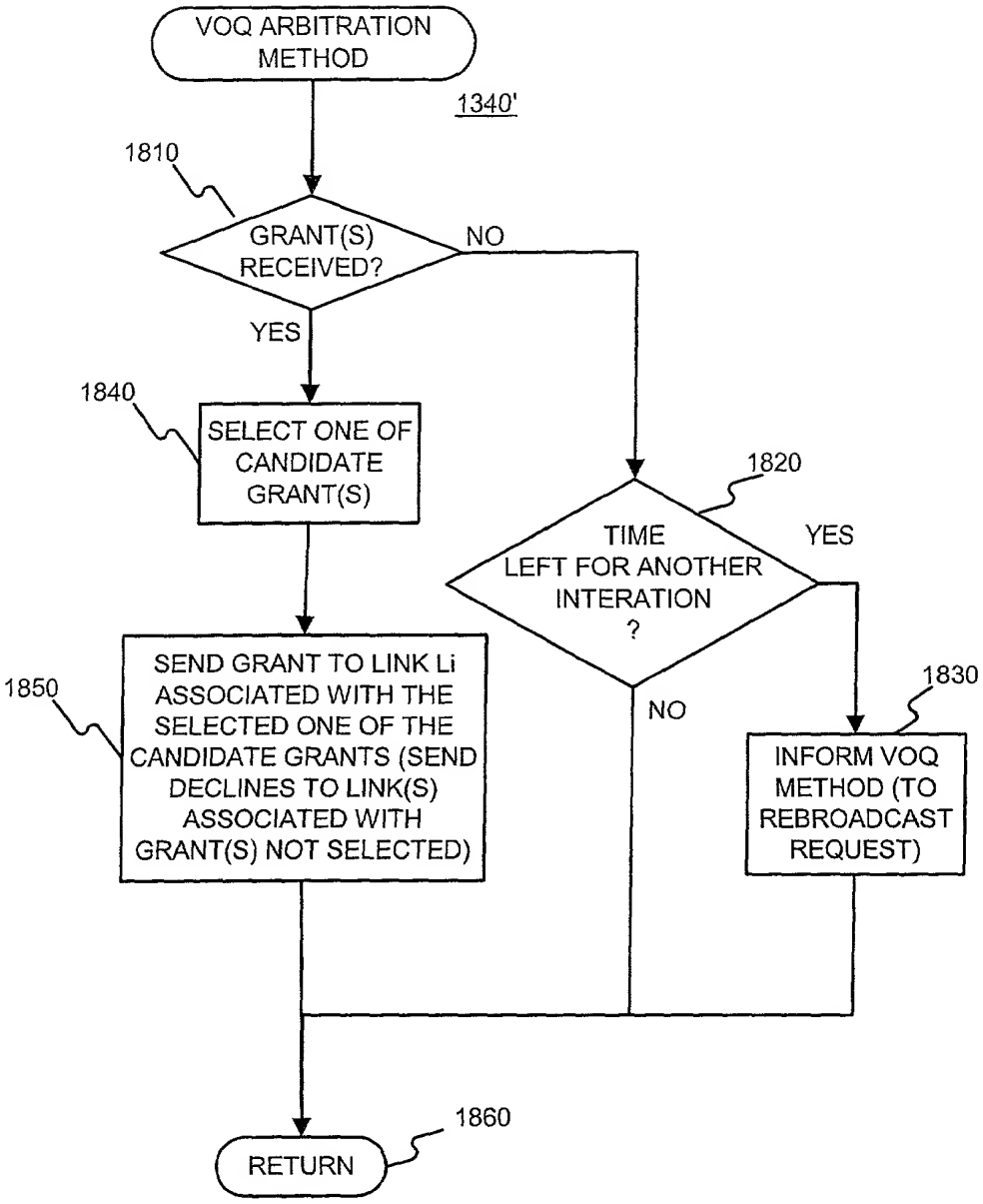
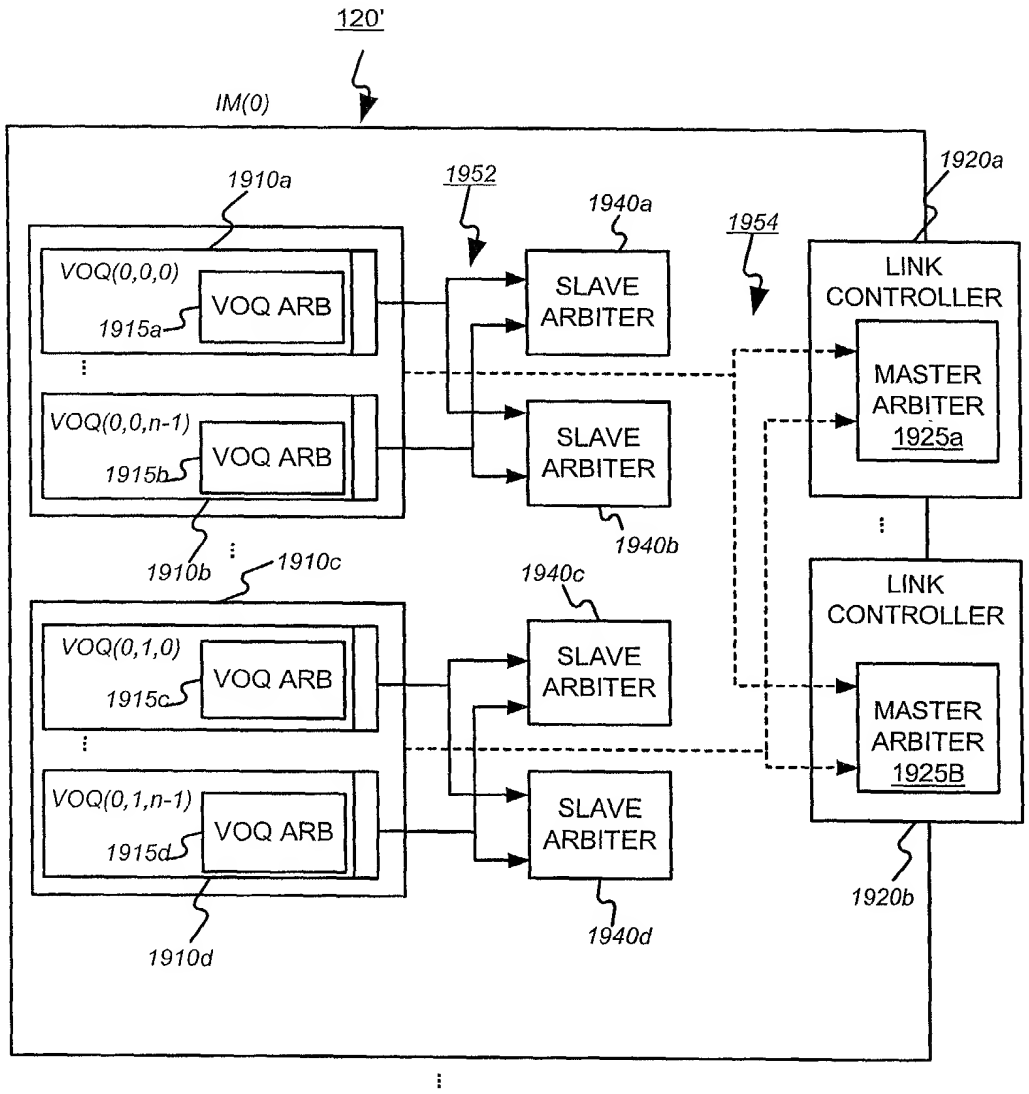
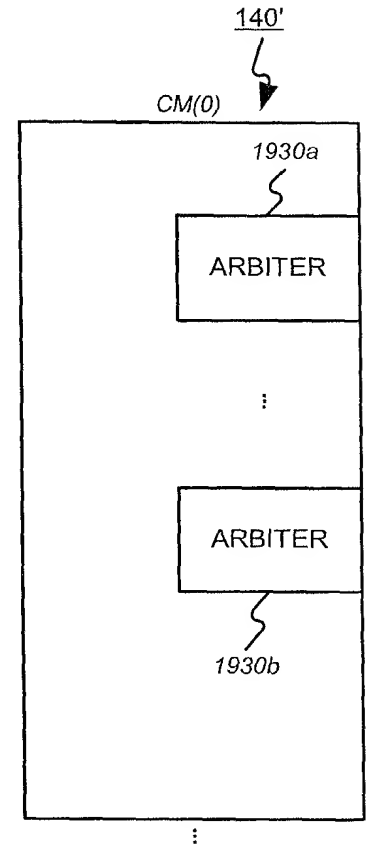


FIGURE 18

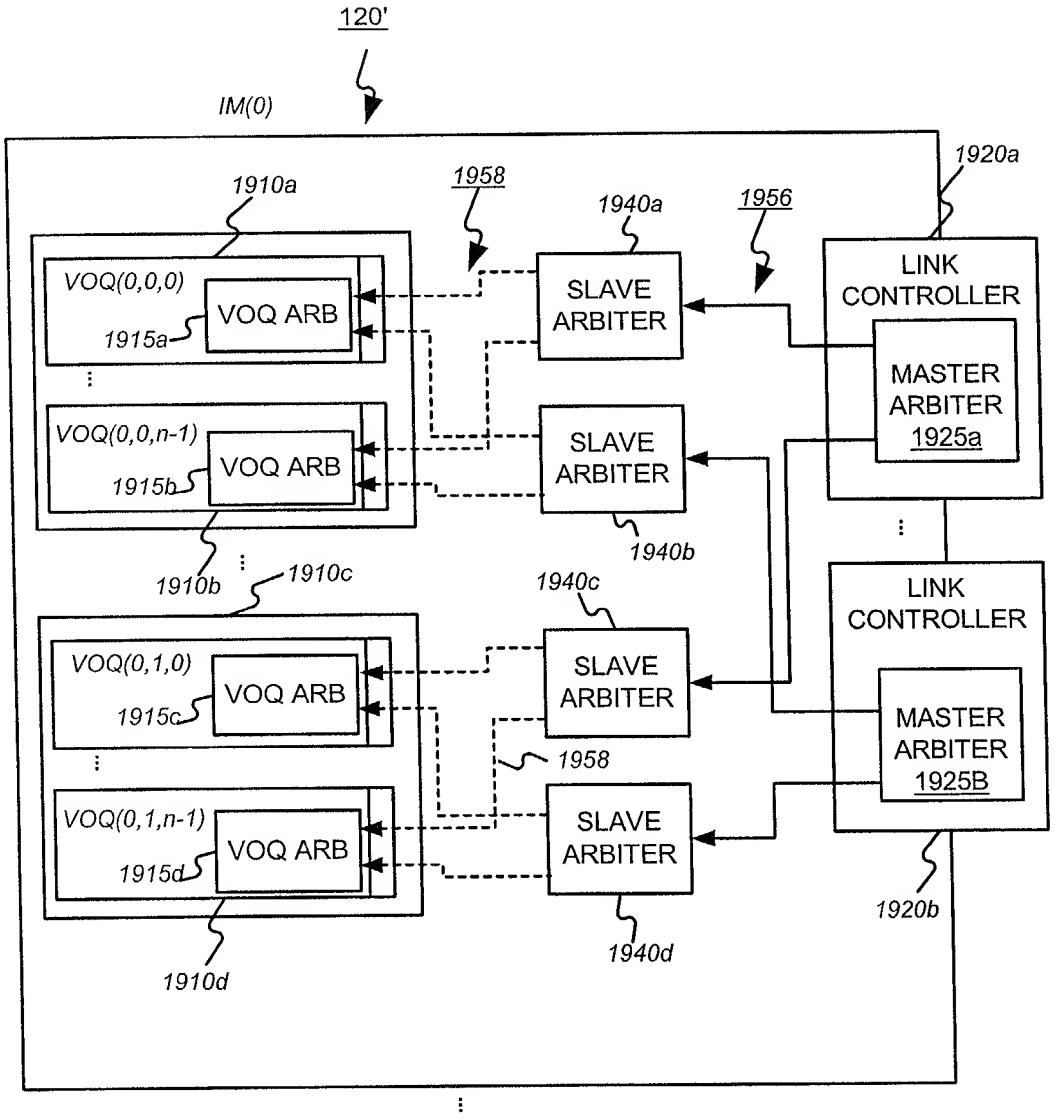
TOE2CO" 8EOFT660

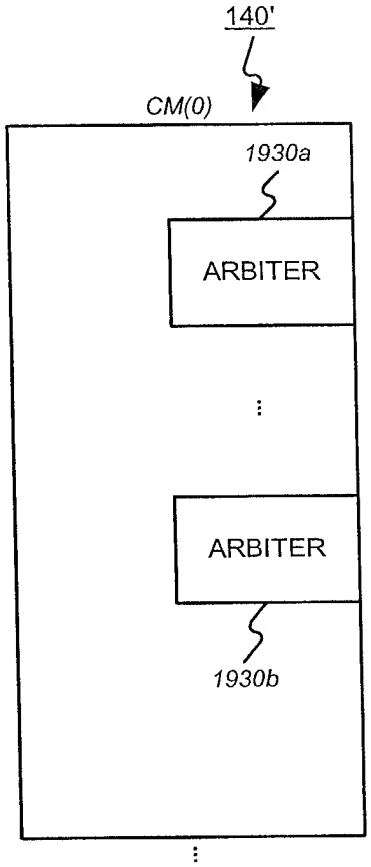




1900

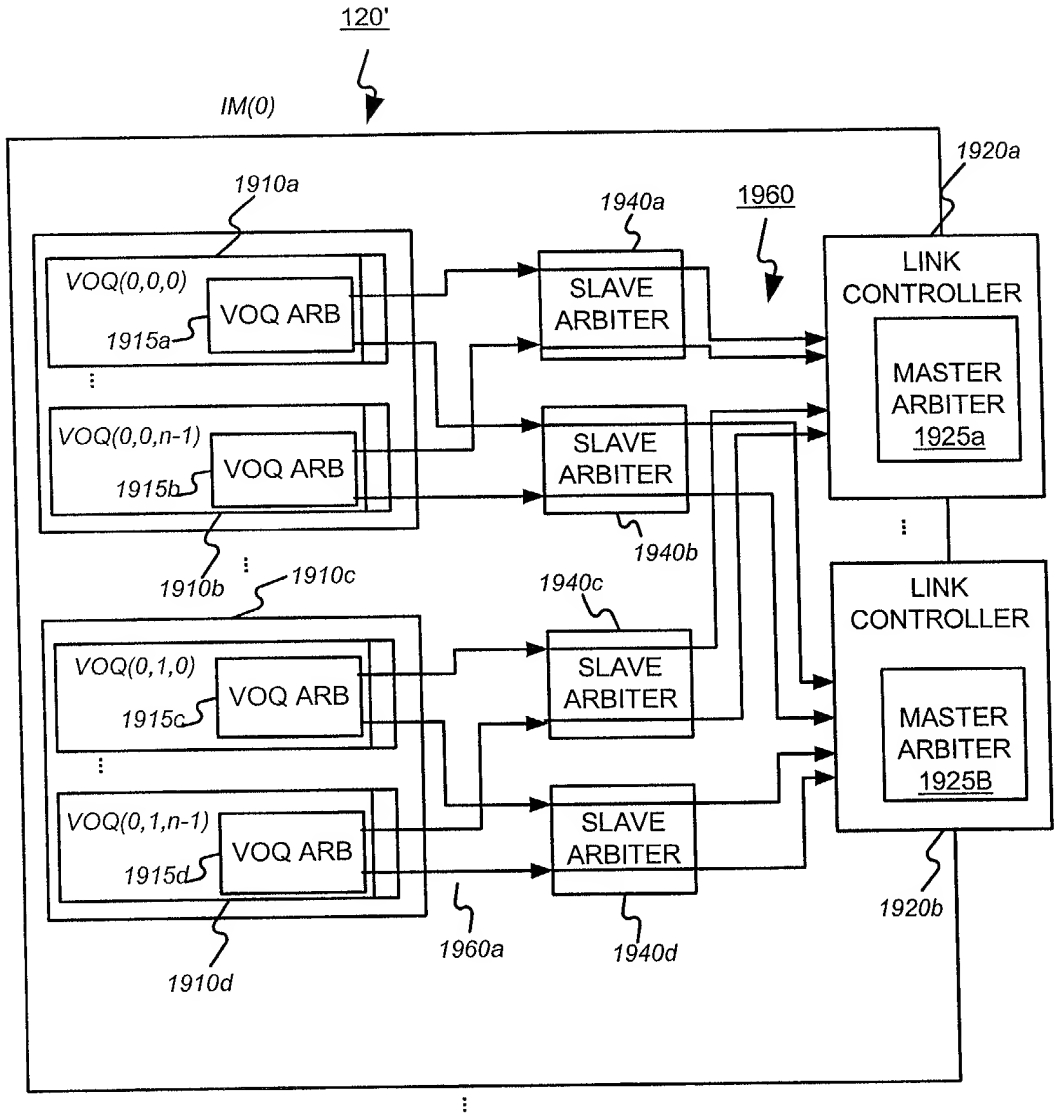
FIGURE 19a

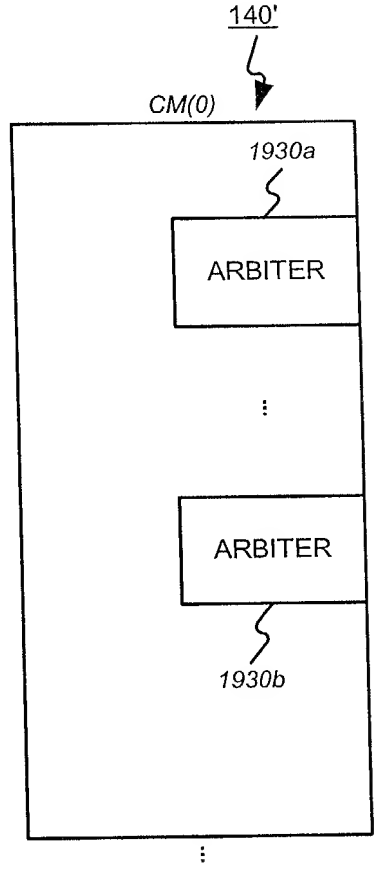




1900

FIGURE 19b





1900

FIGURE 19c

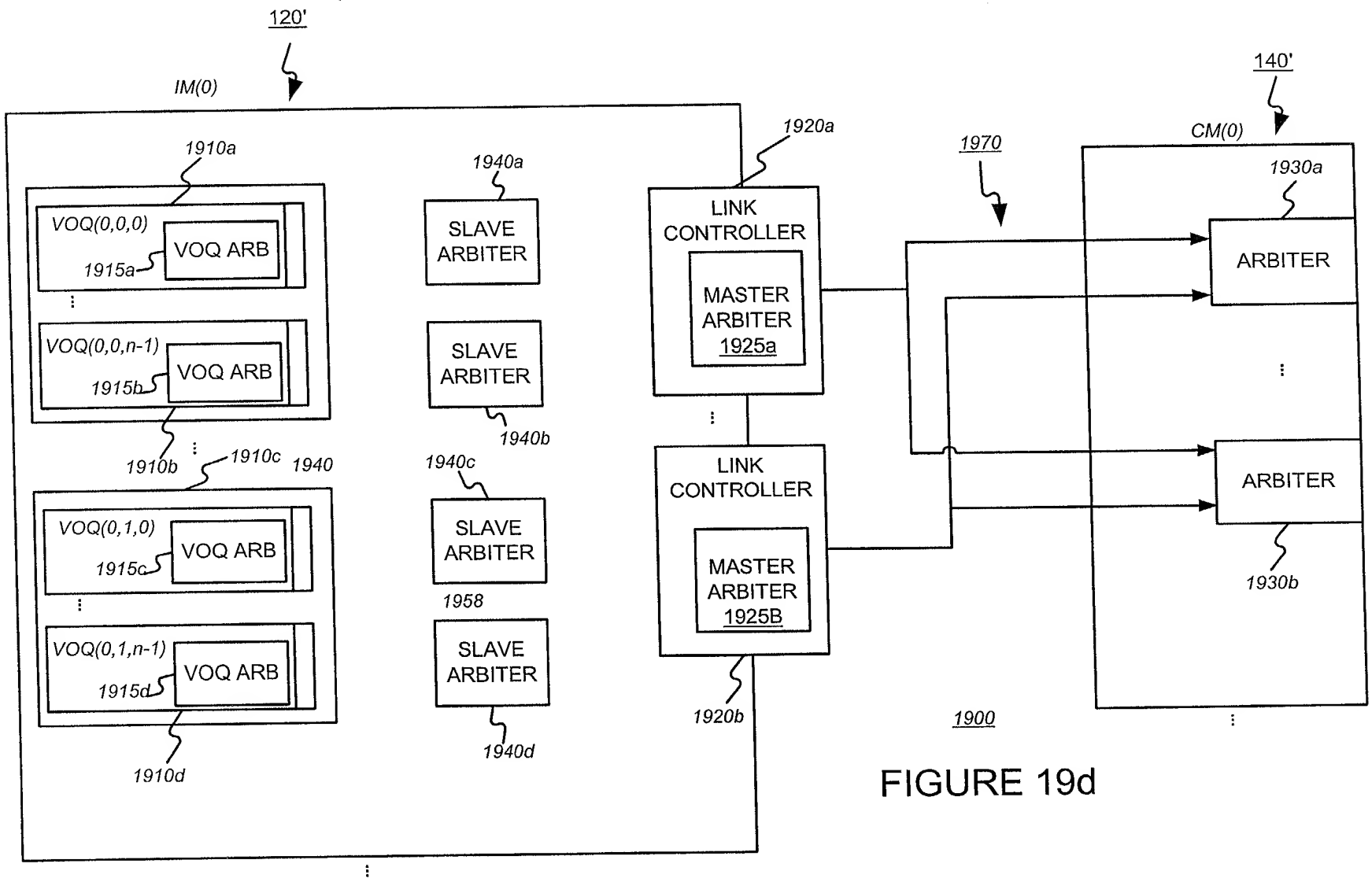

120'
IM(0)
1910a
VOQ(0,0,0)
VOQ ARB
1915a
VOQ(0,0,n-1)
VOQ ARB
1915b
1910b
1910c
1940
VOQ(0,1,0)
VOQ ARB
1915c
VOQ(0,1,n-1)
VOQ ARB
1915d
1910d
1940a
SLAVE ARBITER
SLAVE ARBITER
1940b
1940c
SLAVE ARBITER
1958
SLAVE ARBITER
1940d
1920a
LINK CONTROLLER
MASTER ARBITER 1925a
LINK CONTROLLER
MASTER ARBITER 1925B
1920b
1970
140'
CM(0)
1930a
ARBITER
ARBITER
1930b
1900

FIGURE 19d

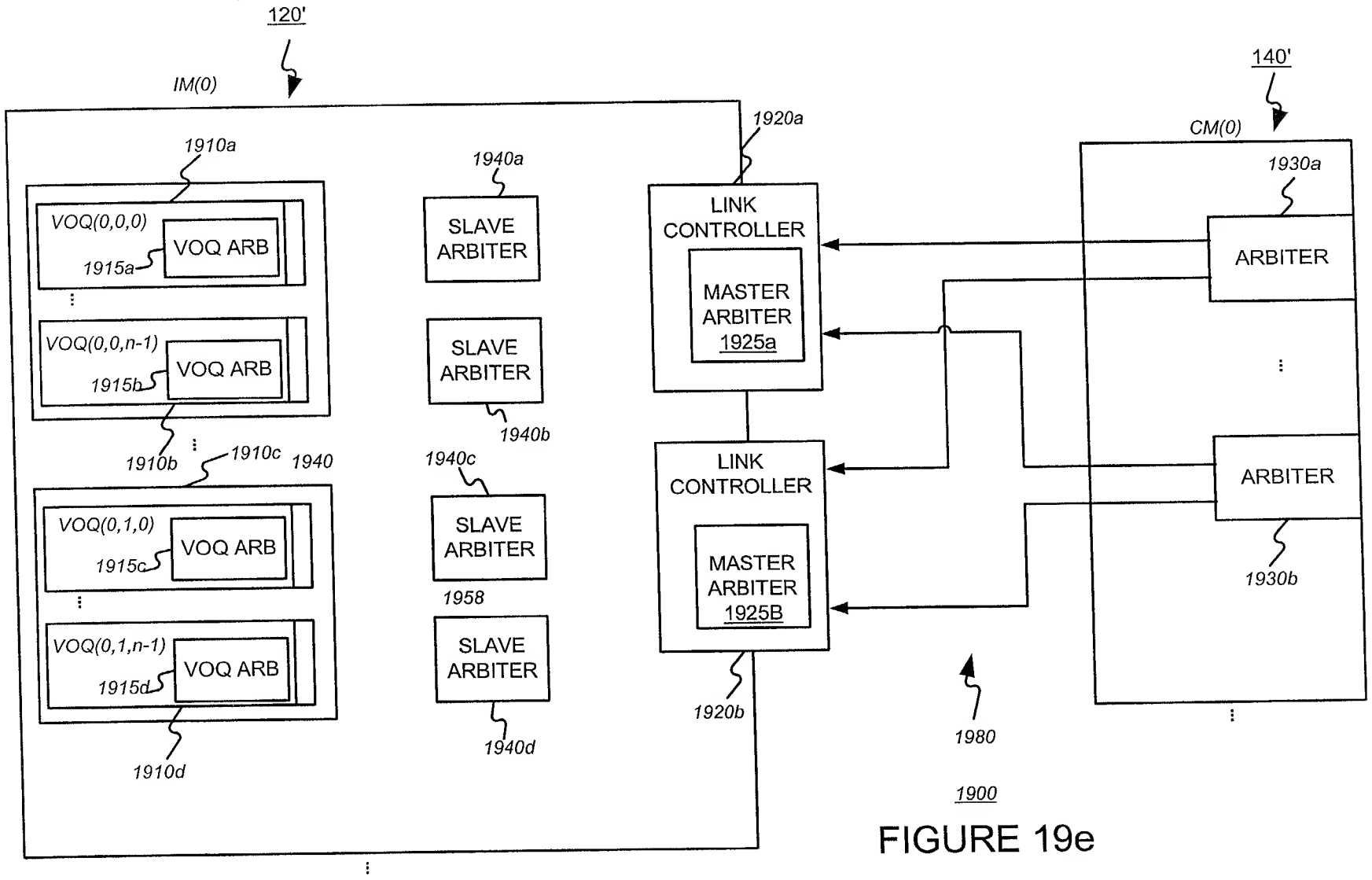
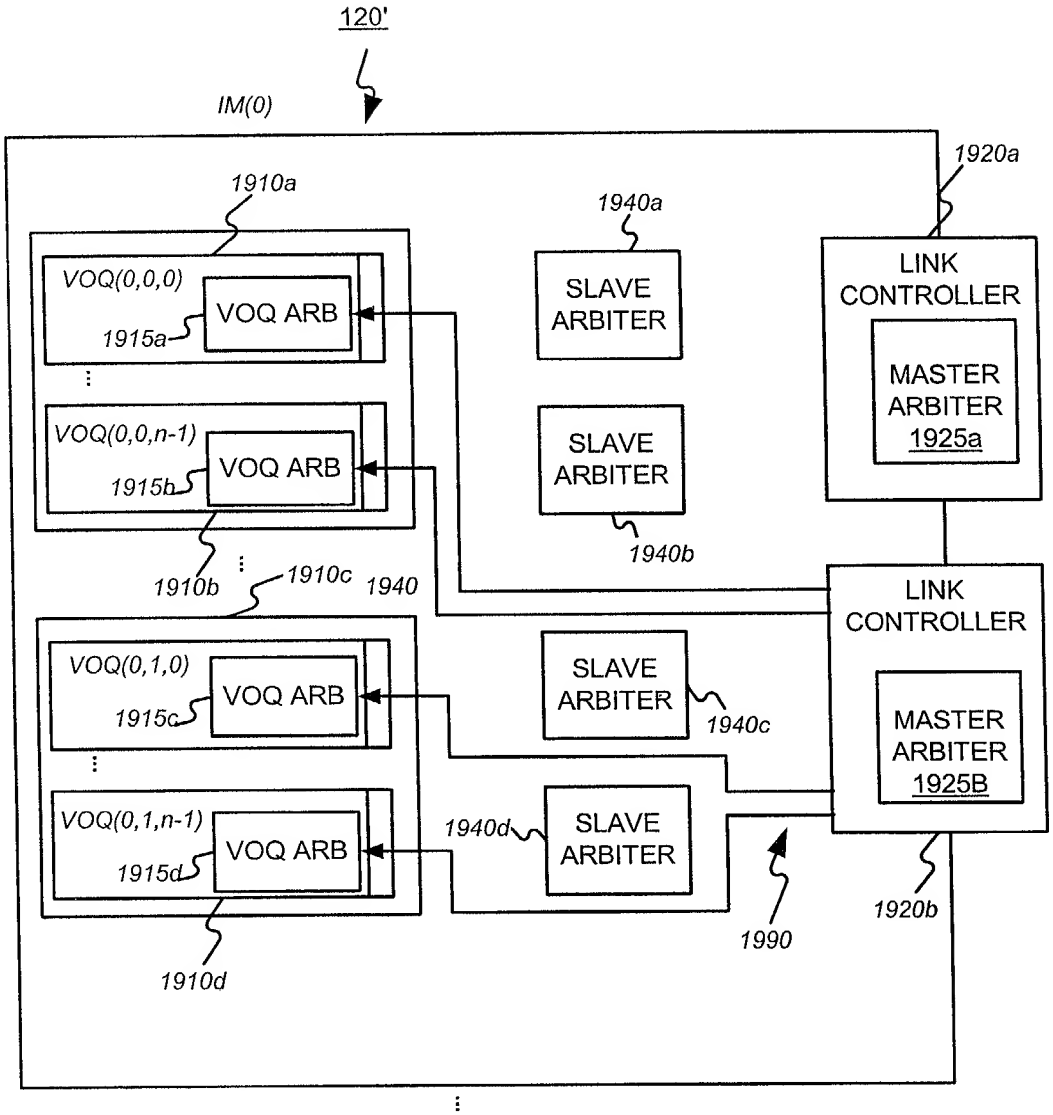
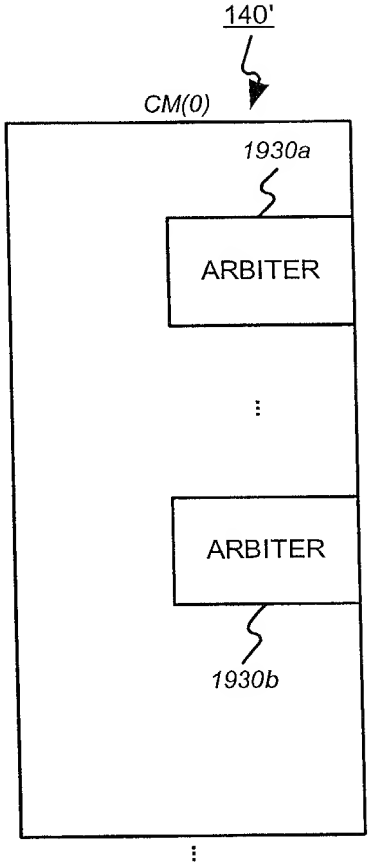

120'
IM(0)
1910a
VOQ(0,0,0)
VOQ ARB
1915a
VOQ(0,0,n-1)
VOQ ARB
1915b
1910b
1910c
1940
VOQ(0,1,0)
VOQ ARB
1915c
VOQ(0,1,n-1)
VOQ ARB
1915d
1910d
1940a
SLAVE ARBITER
SLAVE ARBITER
1940b
1940c
SLAVE ARBITER
1958
SLAVE ARBITER
1940d
1920a
LINK CONTROLLER
MASTER ARBITER 1925a
LINK CONTROLLER
MASTER ARBITER 1925B
1920b
1980
1900
140'
CM(0)
1930a
ARBITER
ARBITER
1930b

FIGURE 19e

TOE220 "BEOTT660

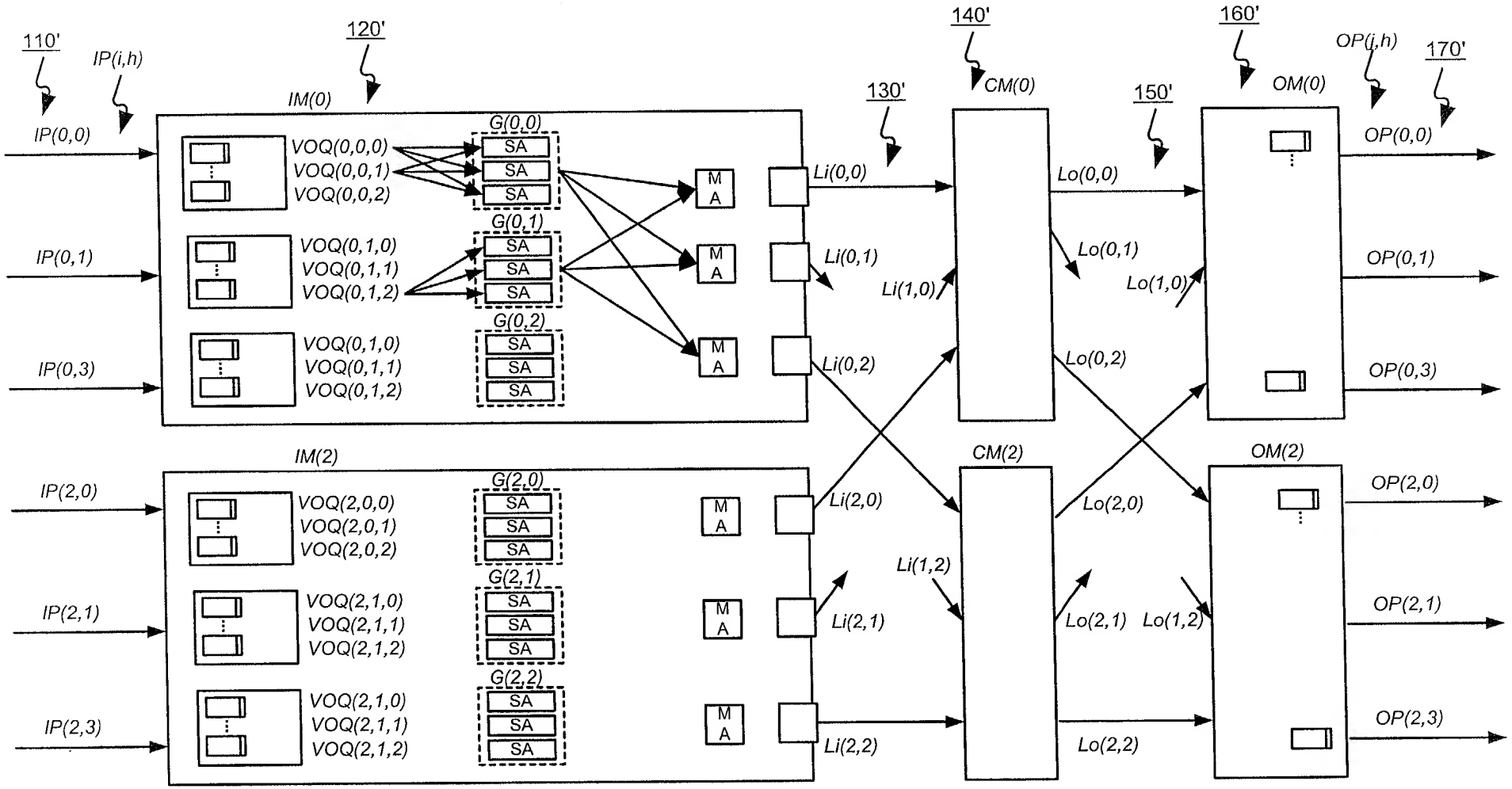




1900

FIGURE 19f

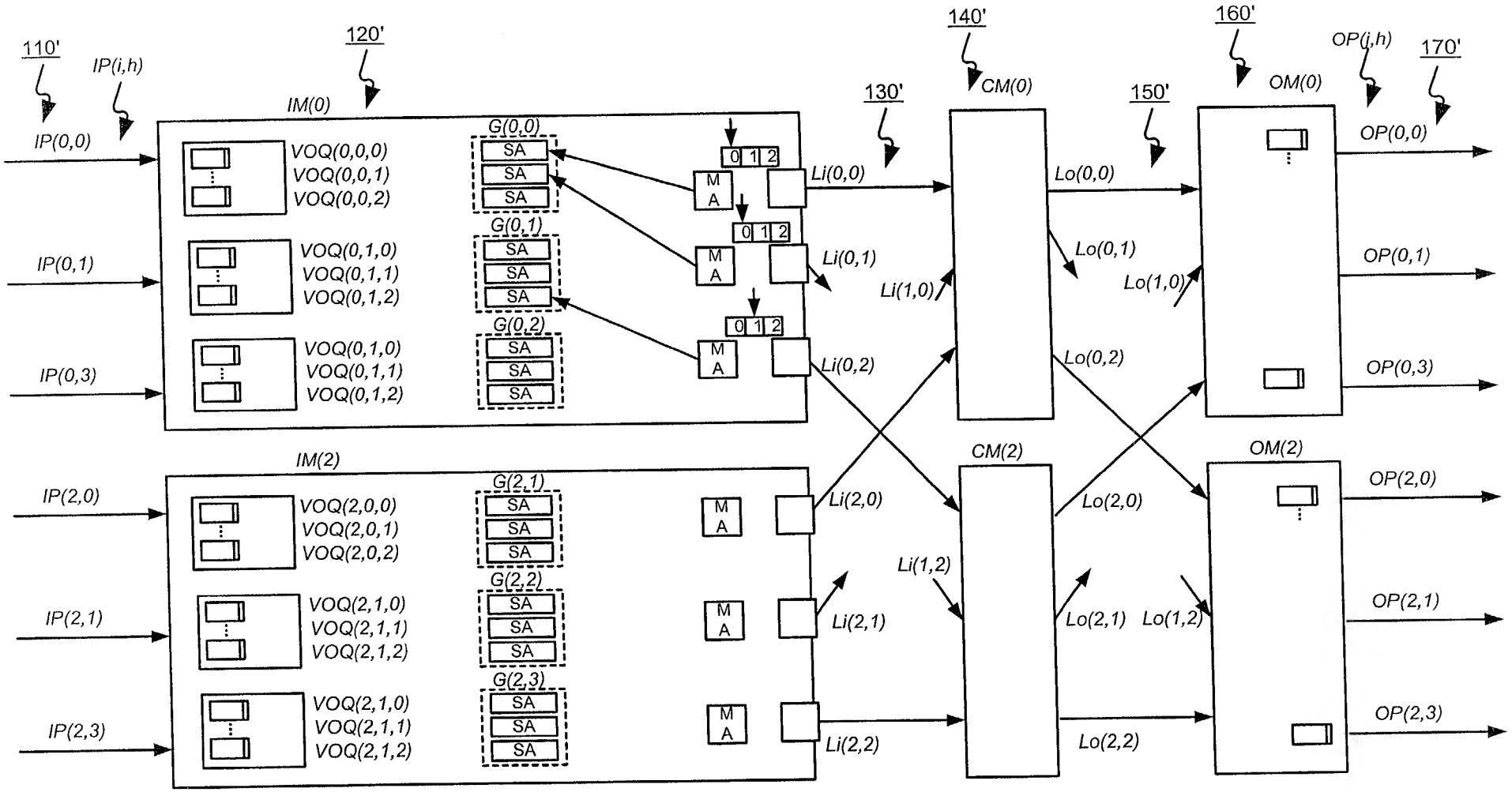
TOE2O" 8EOTT6O



100"

FIGURE 20a

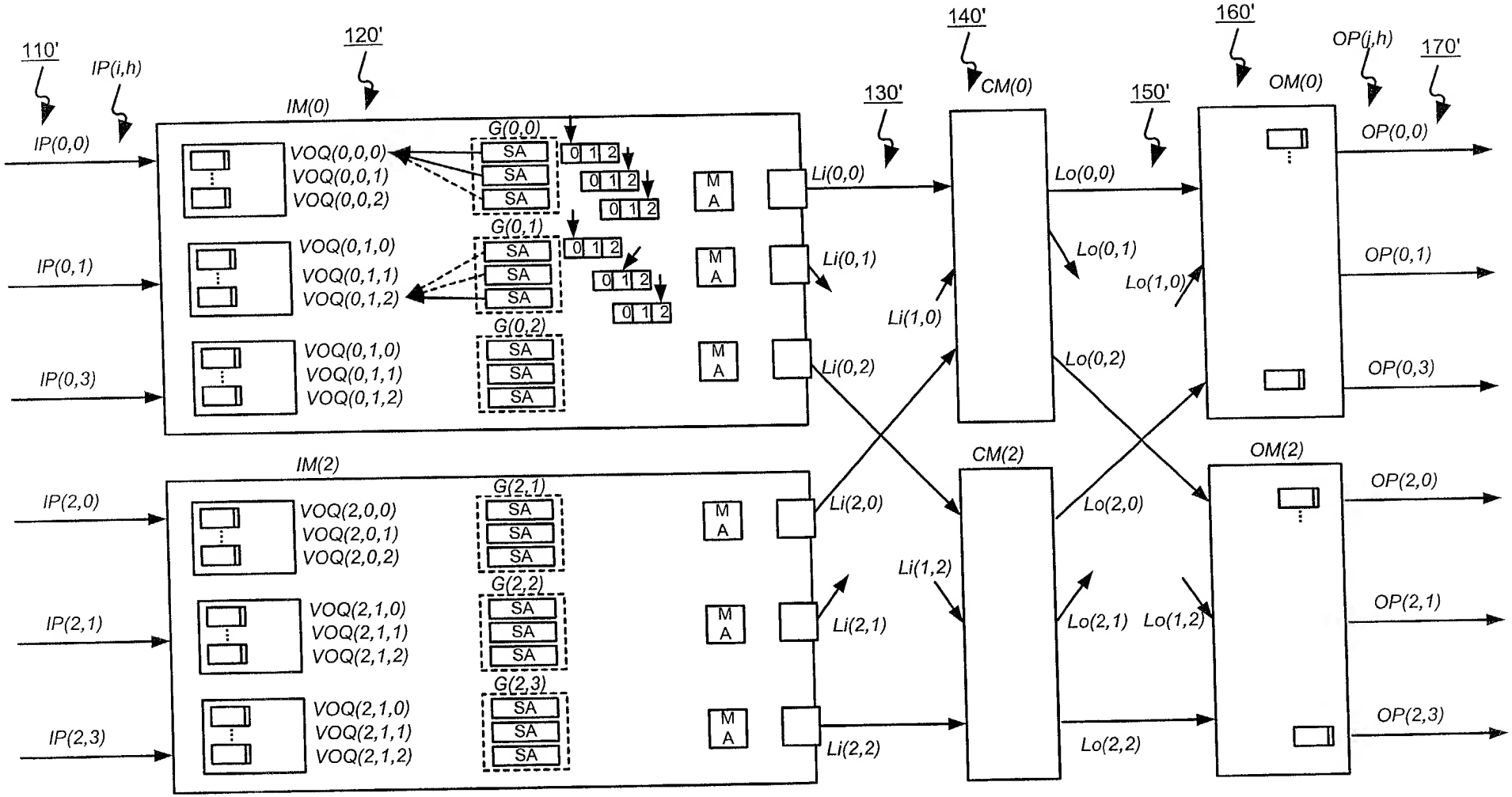
TOE220 "BEOTT660



100"

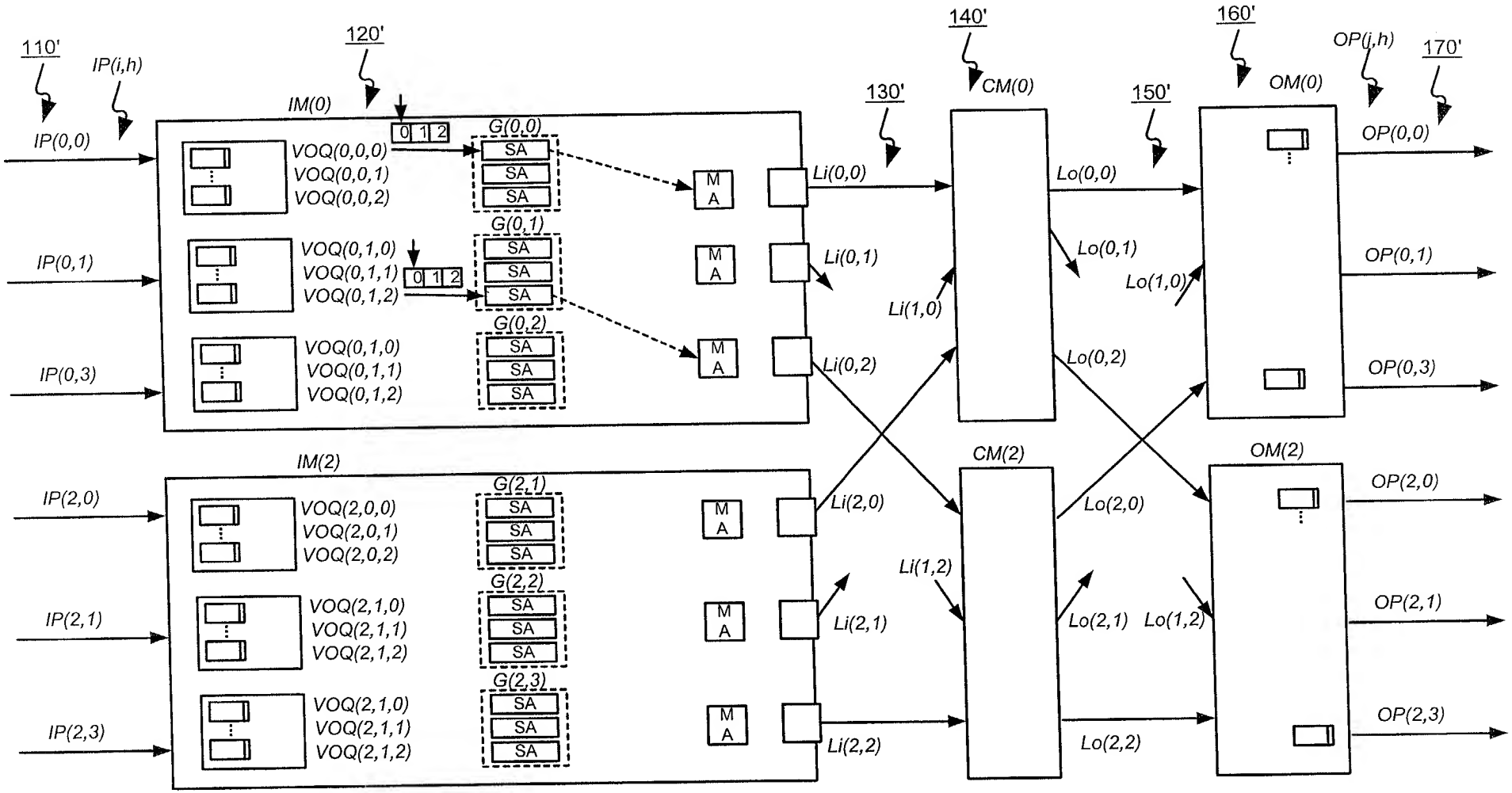
FIGURE 20b

TOE220" BEOTT660



100"

FIGURE 20c



100"

FIGURE 20d

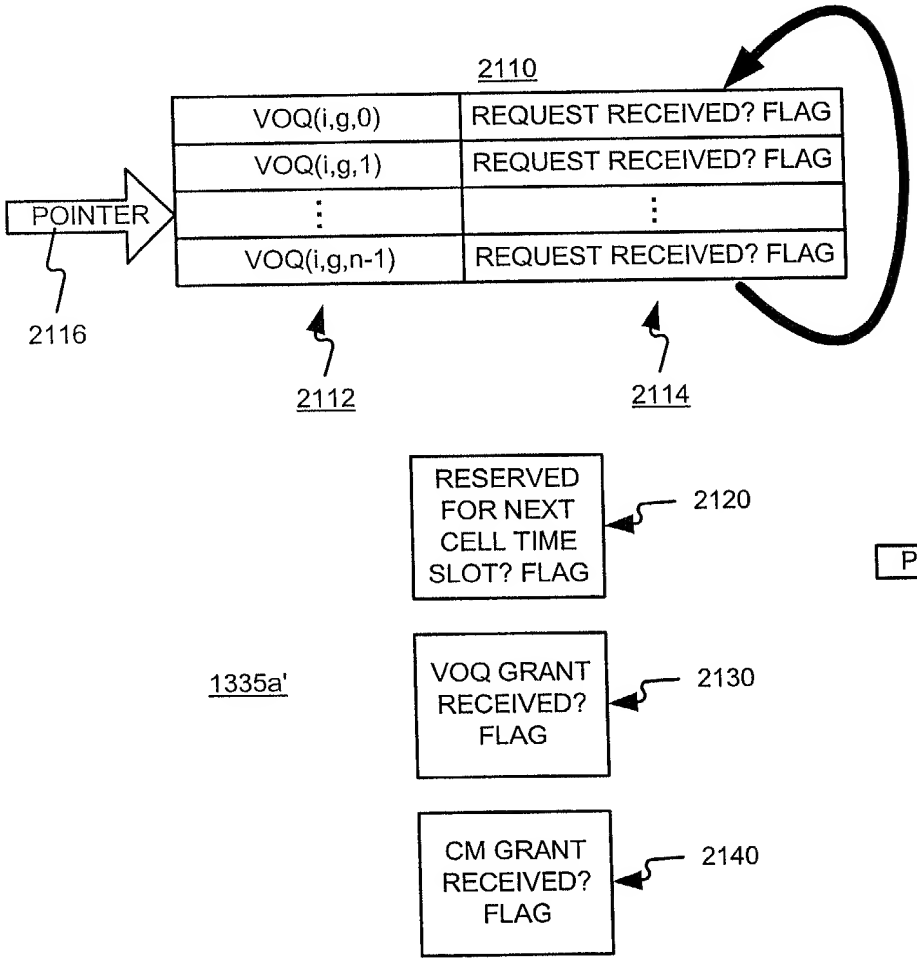


FIGURE 21

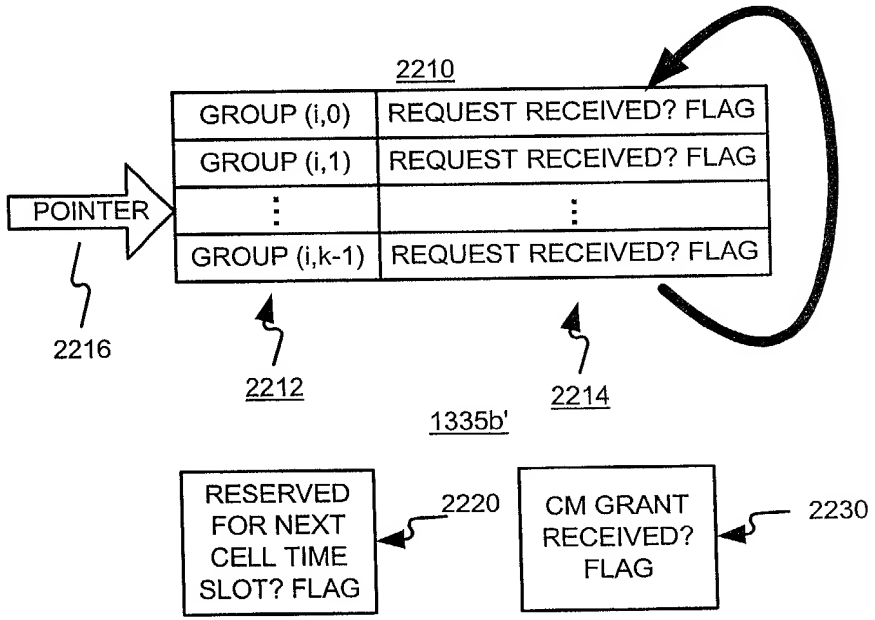
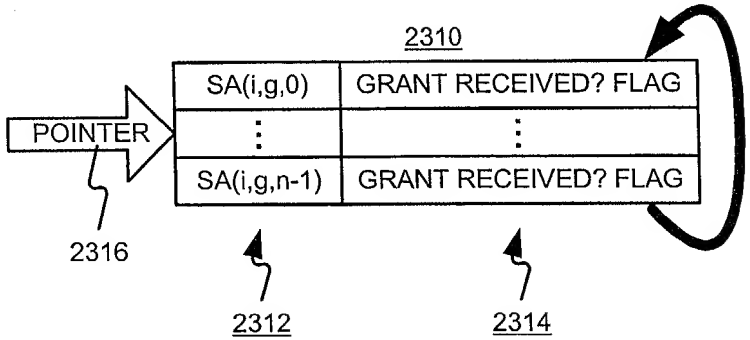


FIGURE 22


2310
SA(i,g,0)
GRANT RECEIVED? FLAG
POINTER
SA(i,g,n-1)
GRANT RECEIVED? FLAG
2316
2312
2314

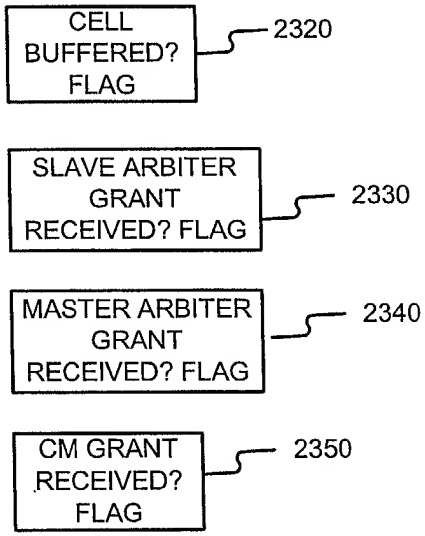
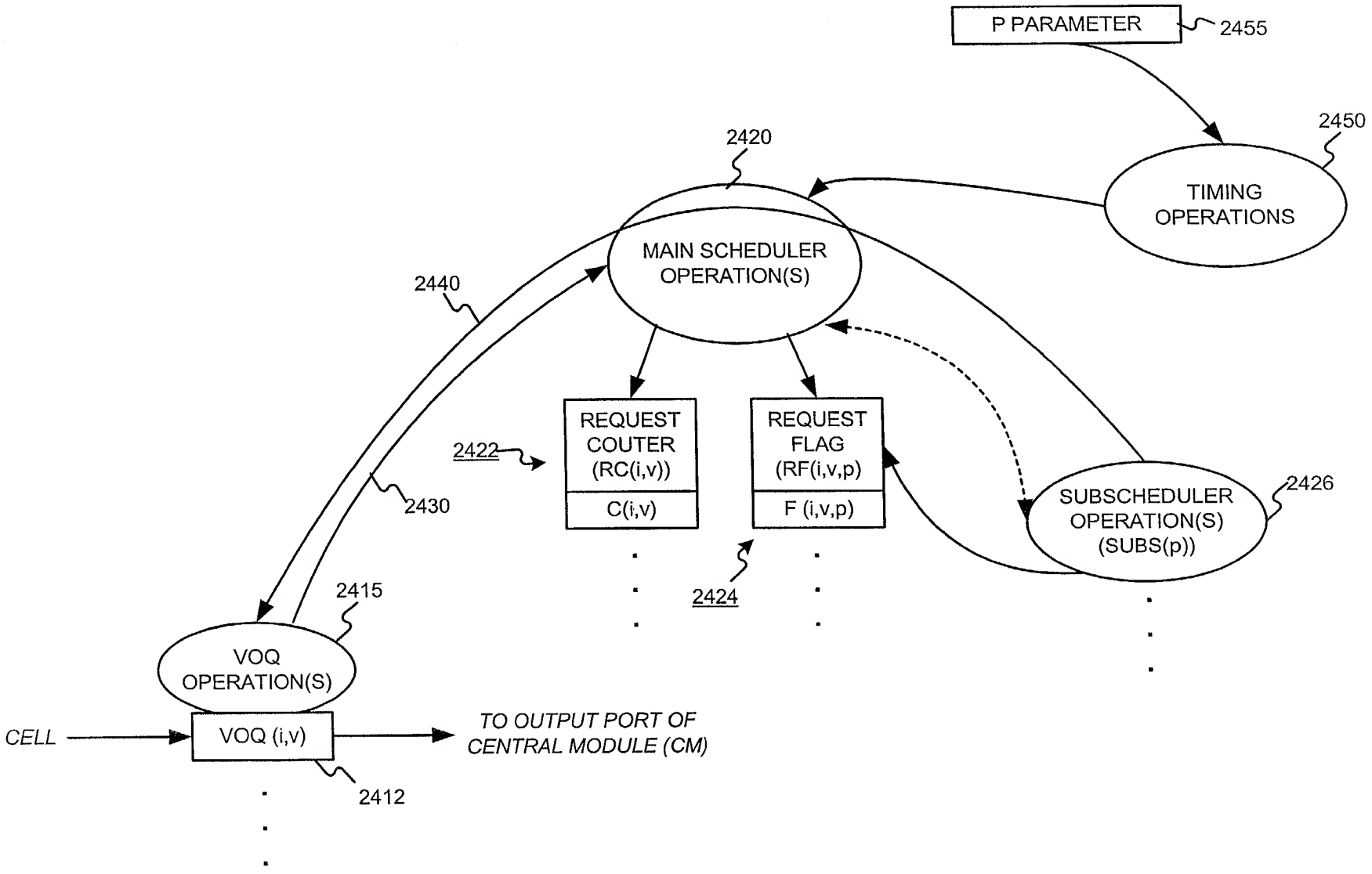

CELL BUFFERED? FLAG
2320
SLAVE ARBITER GRANT RECEIVED? FLAG
2330
MASTER ARBITER GRANT RECEIVED? FLAG
2340
CM GRANT RECEIVED? FLAG
2350
1345'

FIGURE 23



2400

FIGURE 24

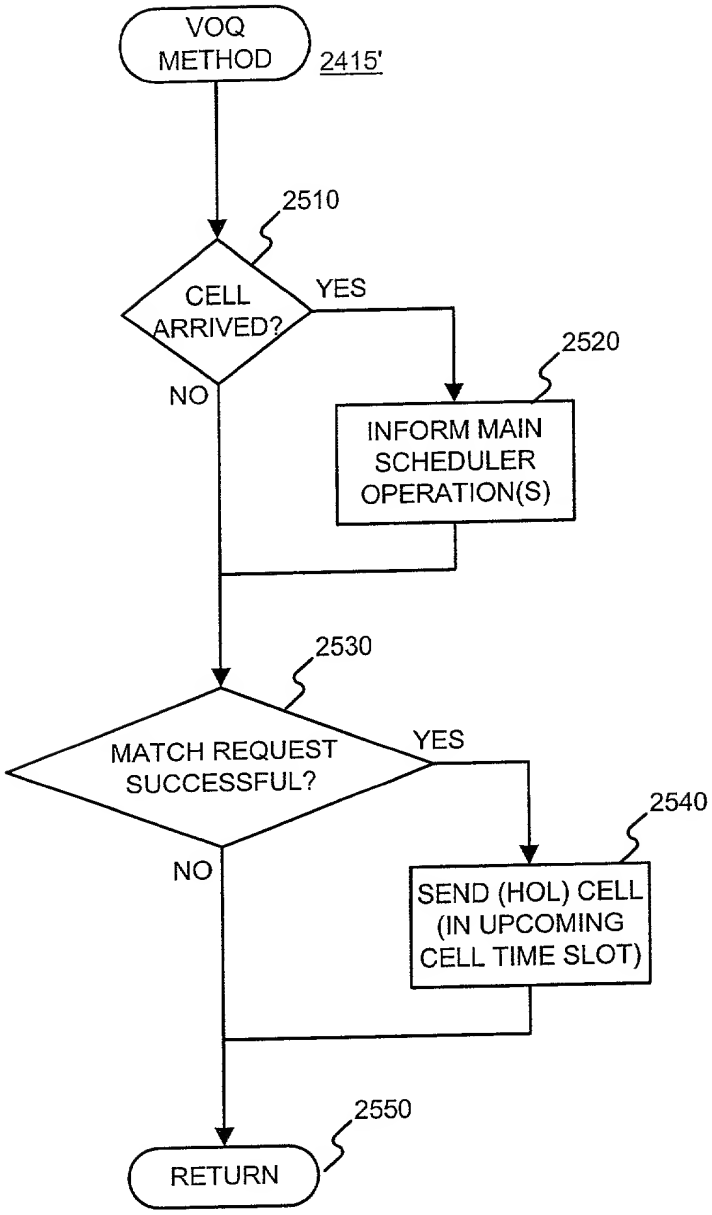

VOQ METHOD
2415'
2510
CELL ARRIVED?
YES
NO
2520
INFORM MAIN SCHEDULER OPERATION(S)
2530
MATCH REQUEST SUCCESSFUL?
YES
NO
2540
SEND (HOL) CELL (IN UPCOMING CELL TIME SLOT)
2550
RETURN

FIGURE 25

Docket No. 95-06-04-US

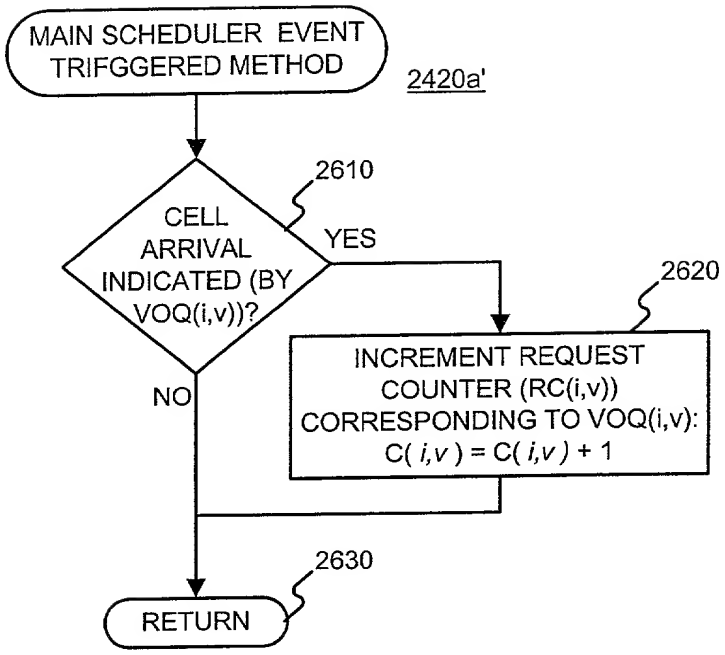


FIGURE 26

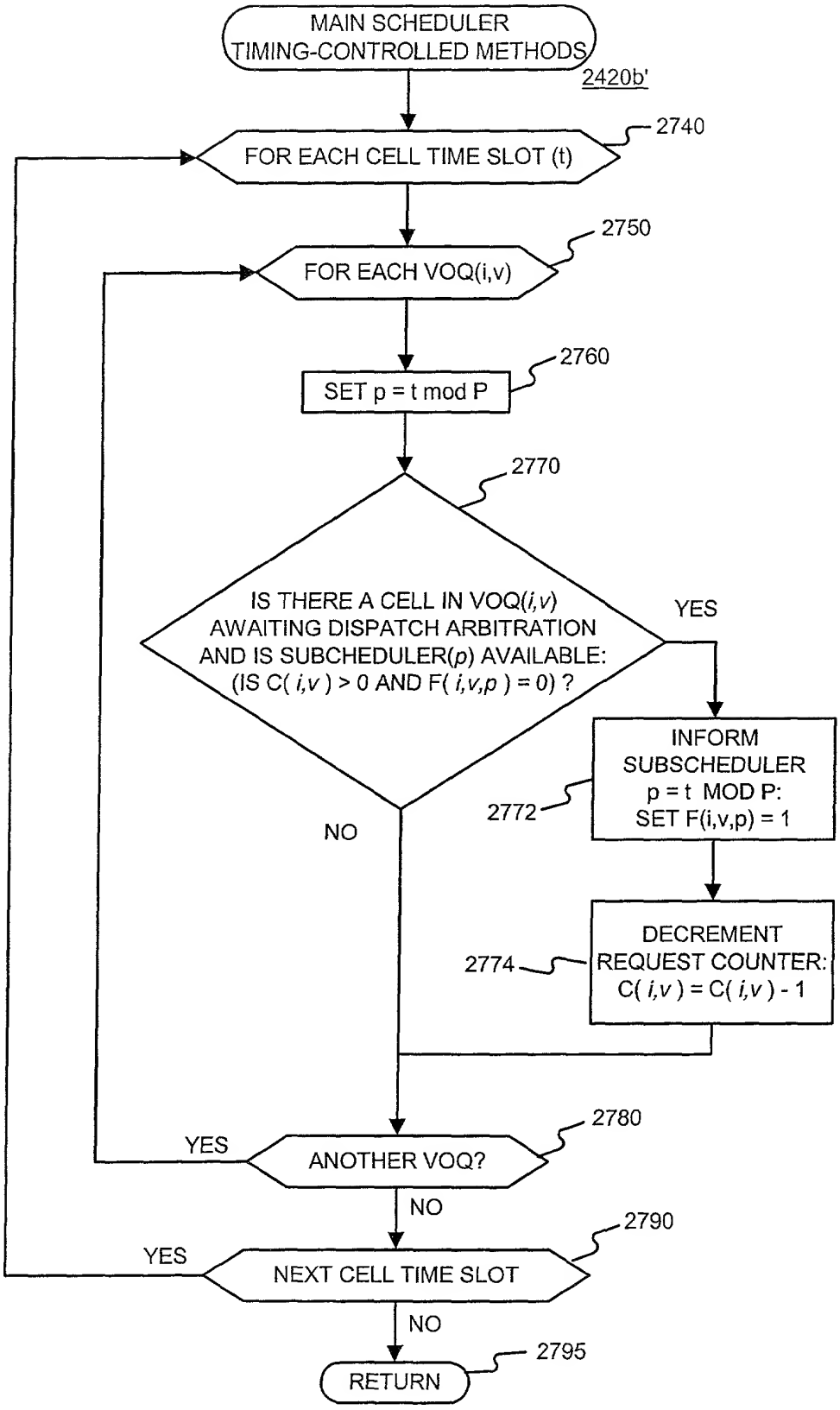

MAIN SCHEDULER
TIMING-CONTROLLED METHODS
2420b'
2740
FOR EACH CELL TIME SLOT (t)
2750
FOR EACH VOQ(i,v)
2760
SET p = t mod P
2770
IS THERE A CELL IN VOQ(i,v)
AWAITING DISPATCH ARBITRATION
AND IS SUBCHEDULER(p) AVAILABLE:
(IS C(i,v) > 0 AND F(i,v,p) = 0) ?
YES
NO
2772
INFORM
SUBSCHEDULER
p = t MOD P:
SET F(i,v,p) = 1
2774
DECREMENT
REQUEST COUNTER:
C(i,v) = C(i,v) - 1
2780
YES
ANOTHER VOQ?
NO
2790
YES
NEXT CELL TIME SLOT
NO
2795
RETURN

FIGURE 27

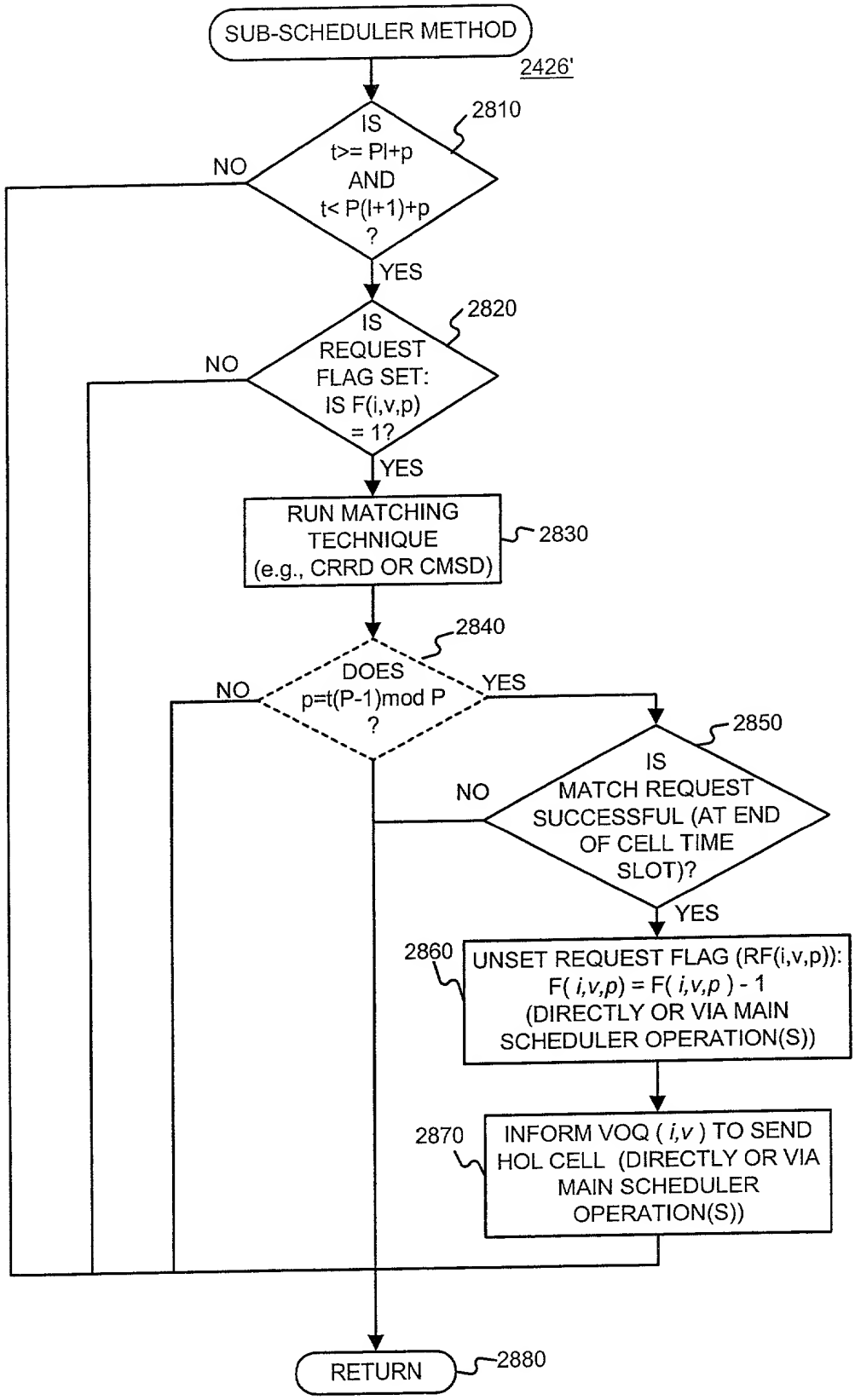

SUB-SCHEDULER METHOD
2426'
IS t>= PI+p AND t< P(I+1)+p ?
2810
NO
YES
IS REQUEST FLAG SET: IS F(i,v,p) = 1?
2820
NO
YES
RUN MATCHING TECHNIQUE (e.g., CRRD OR CMSD)
2830
DOES p=t(P-1)mod P ?
2840
NO
YES
IS MATCH REQUEST SUCCESSFUL (AT END OF CELL TIME SLOT)?
2850
NO
YES
UNSET REQUEST FLAG (RF(i,v,p)): F(i,v,p) = F(i,v,p) - 1 (DIRECTLY OR VIA MAIN SCHEDULER OPERATION(S))
2860
INFORM VOQ (i,v) TO SEND HOL CELL (DIRECTLY OR VIA MAIN SCHEDULER OPERATION(S))
2870
RETURN
2880

FIGURE 28

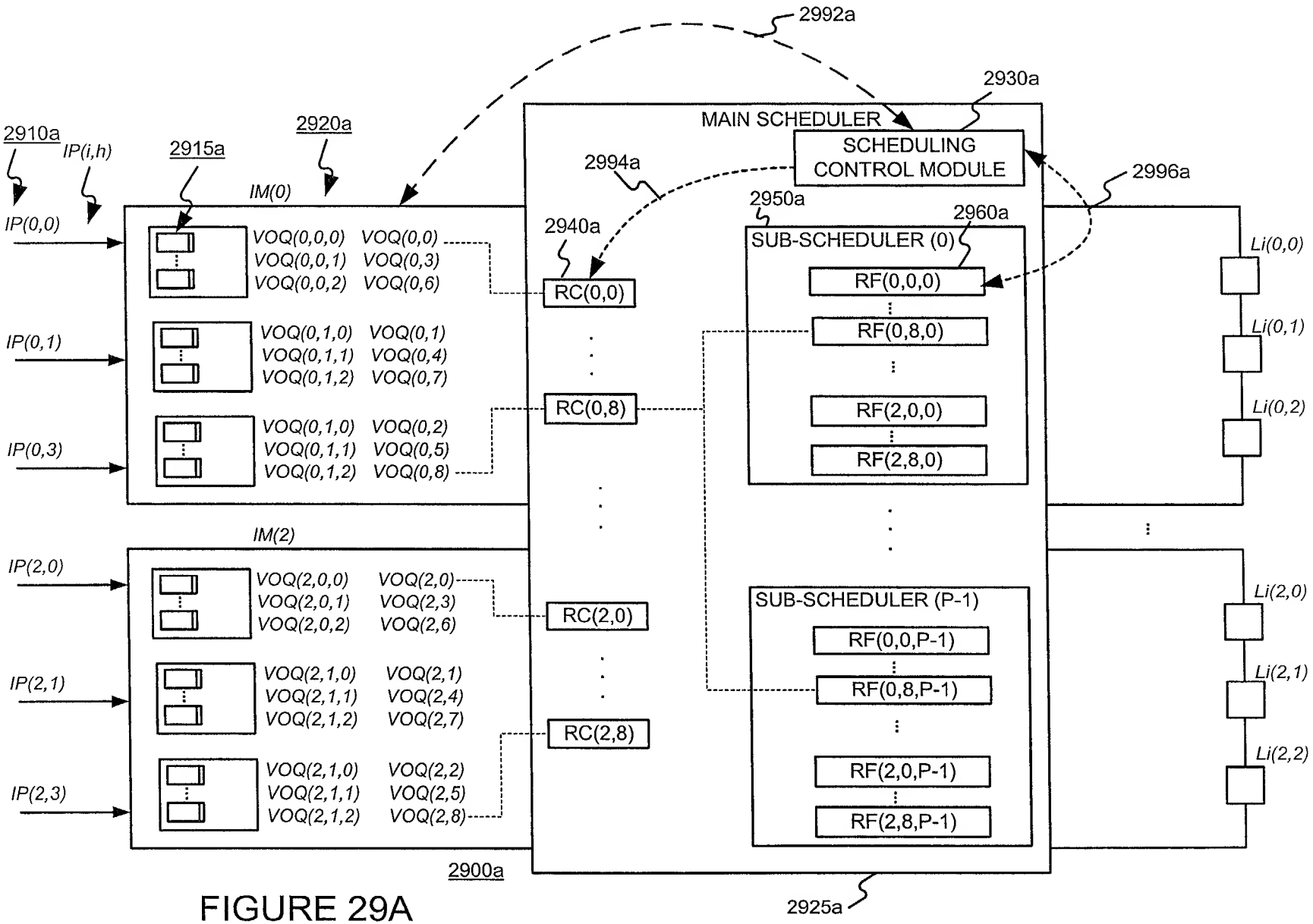

2992a
2930a
MAIN SCHEDULER
SCHEDULING CONTROL MODULE
2910a
IP(i,h)
2915a
2920a
IM(0)
2994a
2996a
2950a
2960a
2940a
SUB-SCHEDULER (0)
IP(0,0)
VOQ(0,0,0) VOQ(0,0)
VOQ(0,0,1) VOQ(0,3)
VOQ(0,0,2) VOQ(0,6)
RC(0,0)
RF(0,0,0)
RF(0,8,0)
IP(0,1)
VOQ(0,1,0) VOQ(0,1)
VOQ(0,1,1) VOQ(0,4)
VOQ(0,1,2) VOQ(0,7)
RC(0,8)
RF(2,0,0)
RF(2,8,0)
IP(0,3)
VOQ(0,1,0) VOQ(0,2)
VOQ(0,1,1) VOQ(0,5)
VOQ(0,1,2) VOQ(0,8)
Li(0,0)
Li(0,1)
Li(0,2)
IM(2)
IP(2,0)
VOQ(2,0,0) VOQ(2,0)
VOQ(2,0,1) VOQ(2,3)
VOQ(2,0,2) VOQ(2,6)
RC(2,0)
SUB-SCHEDULER (P-1)
RF(0,0,P-1)
RF(0,8,P-1)
IP(2,1)
VOQ(2,1,0) VOQ(2,1)
VOQ(2,1,1) VOQ(2,4)
VOQ(2,1,2) VOQ(2,7)
RC(2,8)
RF(2,0,P-1)
RF(2,8,P-1)
IP(2,3)
VOQ(2,1,0) VOQ(2,2)
VOQ(2,1,1) VOQ(2,5)
VOQ(2,1,2) VOQ(2,8)
Li(2,0)
Li(2,1)
Li(2,2)
2900a
2925a

FIGURE 29A

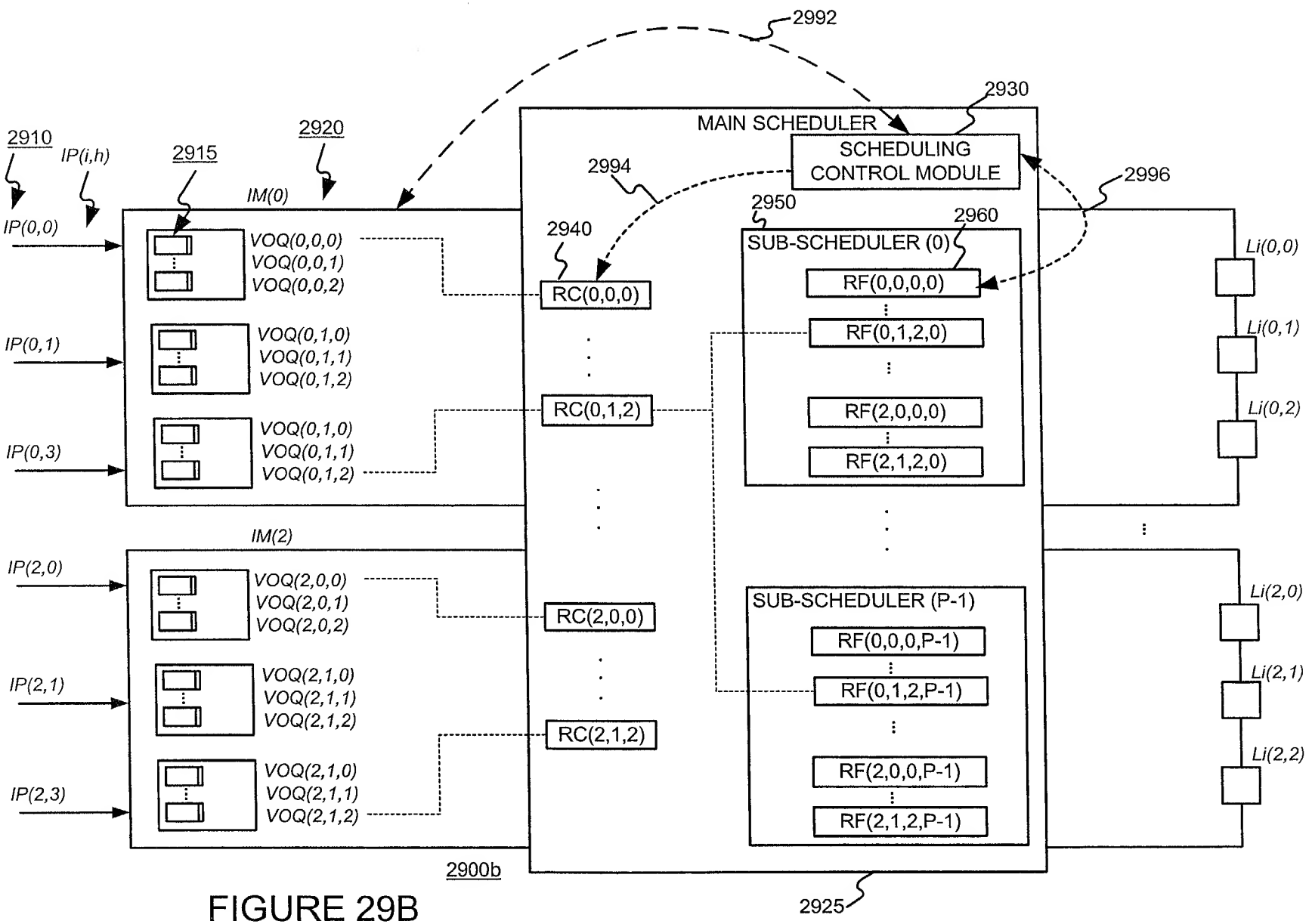
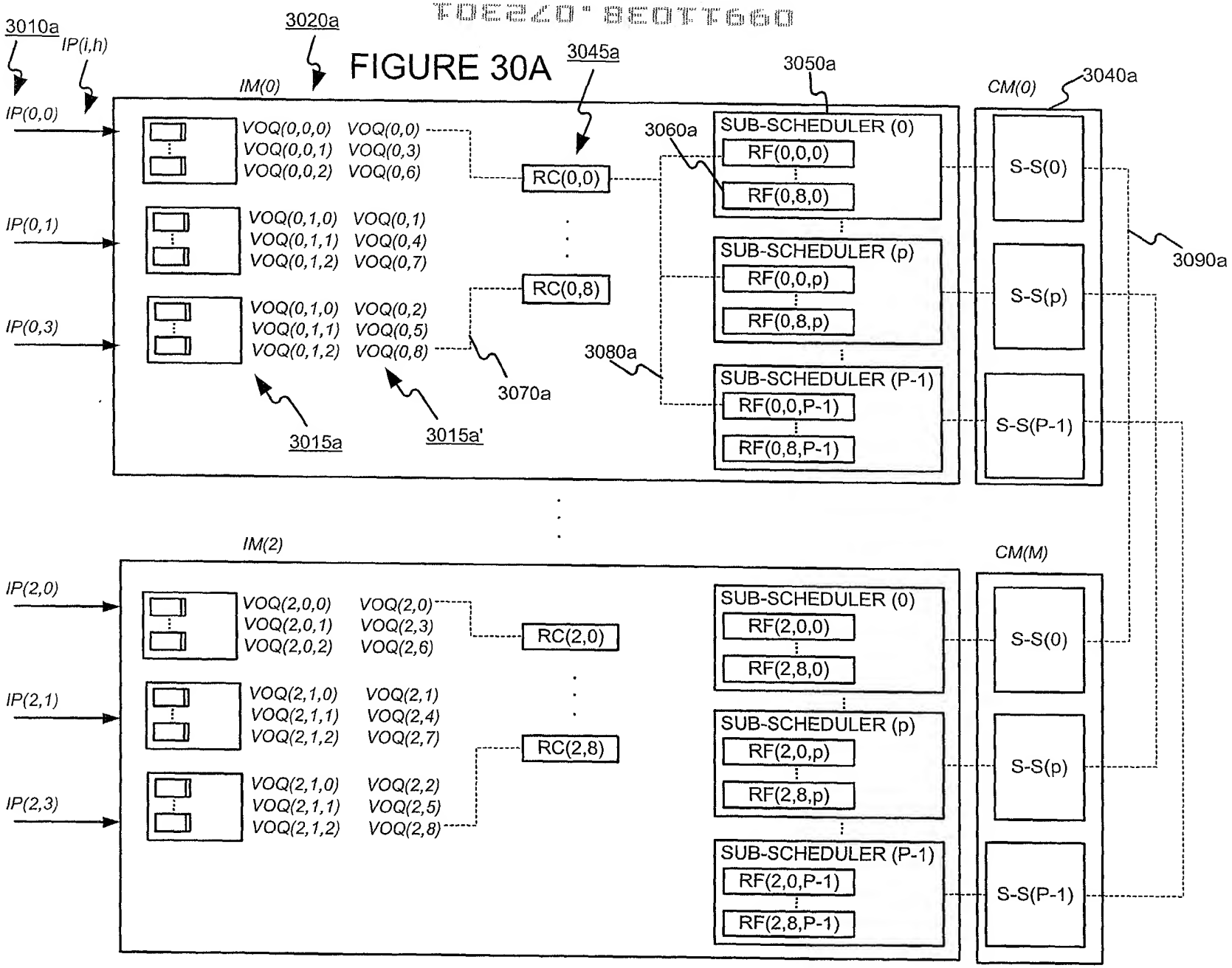
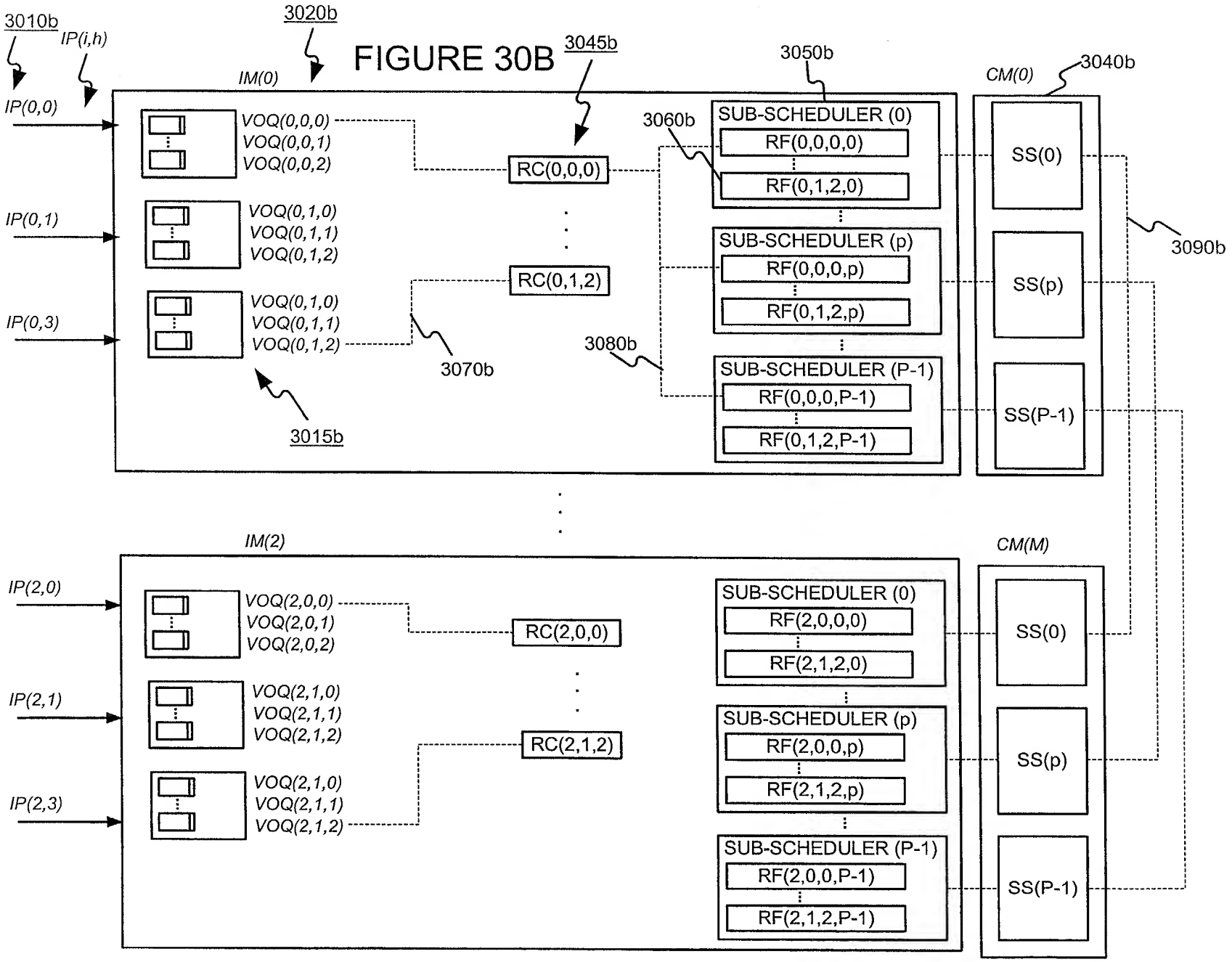

2992
2930
MAIN SCHEDULER
SCHEDULING CONTROL MODULE
2910
IP(i,h)
2915
2920
2994
2996
IM(0)
2950
2960
2940
SUB-SCHEDULER (0)
IP(0,0)
VOQ(0,0,0)
VOQ(0,0,1)
VOQ(0,0,2)
RC(0,0,0)
RF(0,0,0,0)
Li(0,0)
IP(0,1)
VOQ(0,1,0)
VOQ(0,1,1)
VOQ(0,1,2)
RF(0,1,2,0)
Li(0,1)
RC(0,1,2)
RF(2,0,0,0)
Li(0,2)
IP(0,3)
VOQ(0,1,0)
VOQ(0,1,1)
VOQ(0,1,2)
RF(2,1,2,0)
IM(2)
SUB-SCHEDULER (P-1)
IP(2,0)
VOQ(2,0,0)
VOQ(2,0,1)
VOQ(2,0,2)
RC(2,0,0)
RF(0,0,0,P-1)
Li(2,0)
IP(2,1)
VOQ(2,1,0)
VOQ(2,1,1)
VOQ(2,1,2)
RF(0,1,2,P-1)
Li(2,1)
RC(2,1,2)
RF(2,0,0,P-1)
Li(2,2)
IP(2,3)
VOQ(2,1,0)
VOQ(2,1,1)
VOQ(2,1,2)
RF(2,1,2,P-1)
2900b
2925

FIGURE 29B

TOE20 BEOT660

FIGURE 30A




3010b
IP(i,h)
3020b
FIGURE 30B
3045b
3050b
3040b
IM(0)
CM(0)
IP(0,0)
IP(0,1)
IP(0,3)
VOQ(0,0,0)
VOQ(0,0,1)
VOQ(0,0,2)
VOQ(0,1,0)
VOQ(0,1,1)
VOQ(0,1,2)
VOQ(0,1,0)
VOQ(0,1,1)
VOQ(0,1,2)
RC(0,0,0)
RC(0,1,2)
3060b
SUB-SCHEDULER (0)
RF(0,0,0,0)
RF(0,1,2,0)
SUB-SCHEDULER (p)
RF(0,0,0,p)
RF(0,1,2,p)
SUB-SCHEDULER (P-1)
RF(0,0,0,P-1)
RF(0,1,2,P-1)
SS(0)
SS(p)
SS(P-1)
3090b
3080b
3070b
3015b
IM(2)
CM(M)
IP(2,0)
IP(2,1)
IP(2,3)
VOQ(2,0,0)
VOQ(2,0,1)
VOQ(2,0,2)
VOQ(2,1,0)
VOQ(2,1,1)
VOQ(2,1,2)
VOQ(2,1,0)
VOQ(2,1,1)
VOQ(2,1,2)
RC(2,0,0)
RC(2,1,2)
SUB-SCHEDULER (0)
RF(2,0,0,0)
RF(2,1,2,0)
SUB-SCHEDULER (p)
RF(2,0,0,p)
RF(2,1,2,p)
SUB-SCHEDULER (P-1)
RF(2,0,0,P-1)
RF(2,1,2,P-1)
SS(0)
SS(p)
SS(P-1)

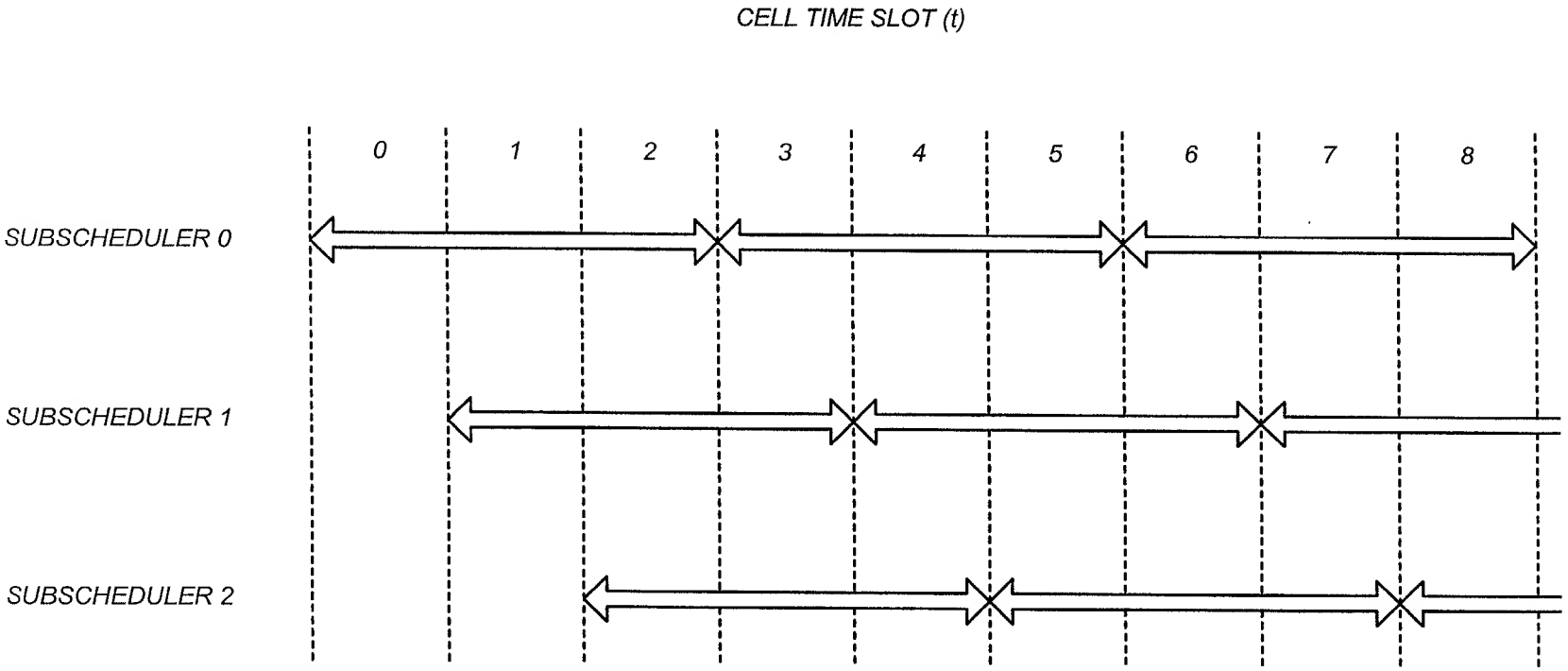

CELL TIME SLOT (t)
0
1
2
3
4
5
6
7
8
SUBSCHEDULER 0
SUBSCHEDULER 1
SUBSCHEDULER 2

FIGURE 31